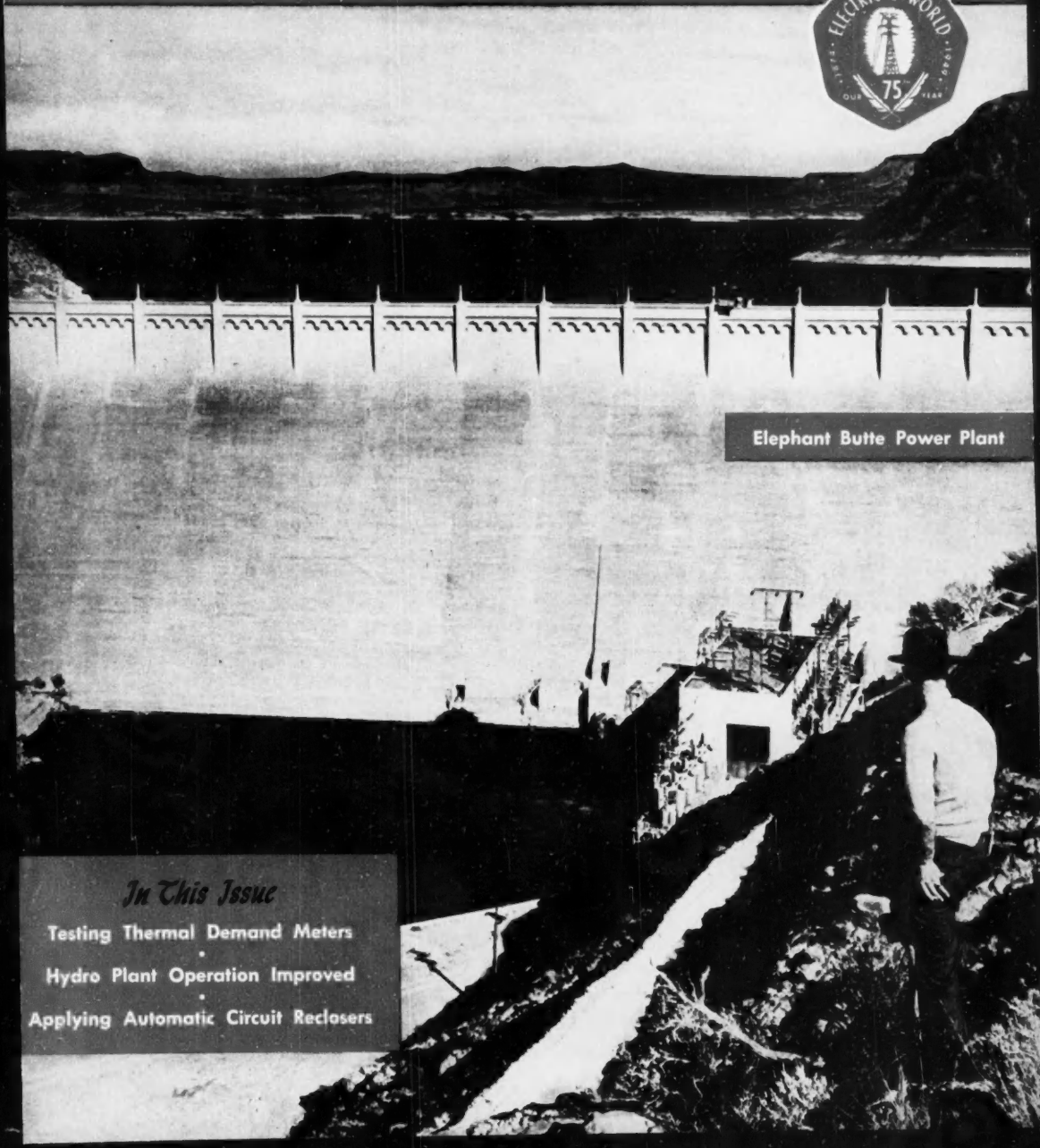
ELECTRICAL WORLD

A McGRAW-HILL PUBLICATION

APRIL 23, 1949



Elephant Butte Power Plant

In This Issue

Testing Thermal Demand Meters

•

Hydro Plant Operation Improved

•

Applying Automatic Circuit Reclosers

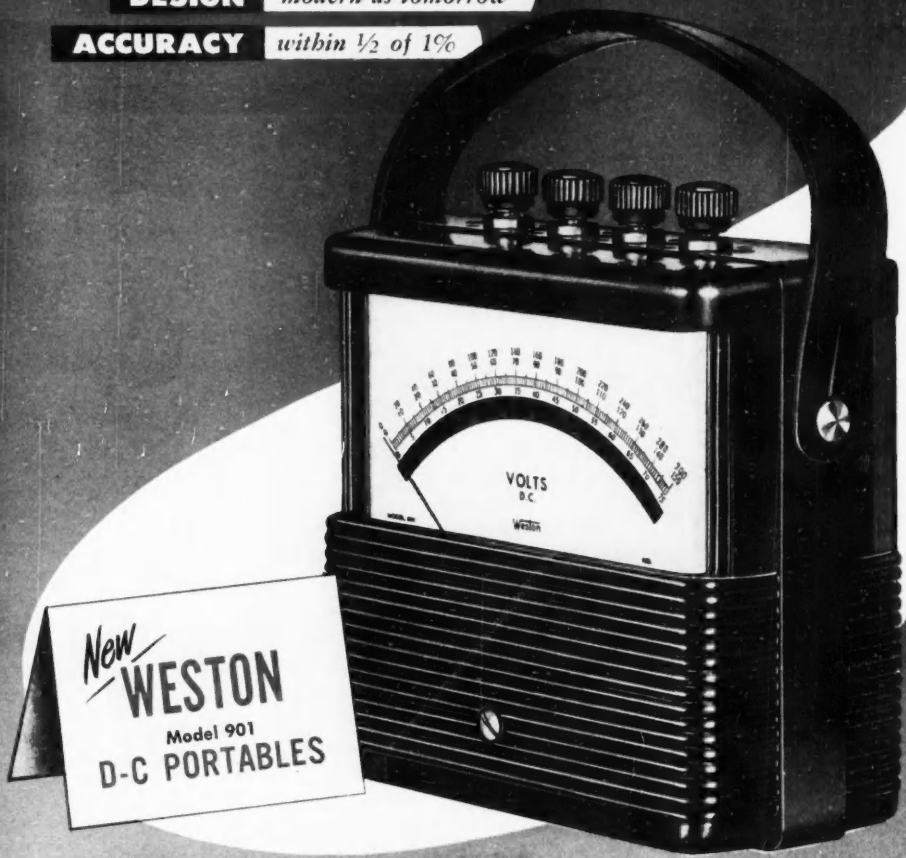
MECHANISM *completely new*

SCALE *unmatched readability*

SHIELDING *far beyond prior concepts*

DESIGN *modern as tomorrow*

ACCURACY *within ½ of 1%*



New WESTON
Model 901
D-C PORTABLES

As to Shielding one user writes: "Making frequent voltage measurements with your Model 901, in the heavy magnetic field near a 15,000 ampere bus, the meter consistently checks well within the guaranteed accuracy."

Available in D-C, Model 901; and A-C, Model 904, single and multiple ranges of wide coverage. Ask your local Weston representative for the facts, or write . . . WESTON Electrical Instrument Corporation, 617 Frelinghuysen Avenue, Newark 5, New Jersey.

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Albany • Atlanta • Boston • Buffalo • Charlotte • Chicago • Cincinnati • Cleveland • Dallas • Denver • Detroit • Houston • Jacksonville • Knoxville • Little Rock • Los Angeles • Meridan • Minneapolis • Newark
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ELECTRICAL WORLD

Published for 75 years for those engaged in the business of generating, transmitting, distributing or applying electric power

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COVER PICTURE—Operation of the Elephant Butte Power Plant, New Mexico is improved by changing turbine runners to match cyclic changes in hydraulic head. The changes occur at long intervals of approximately 5 to 10 years on the average

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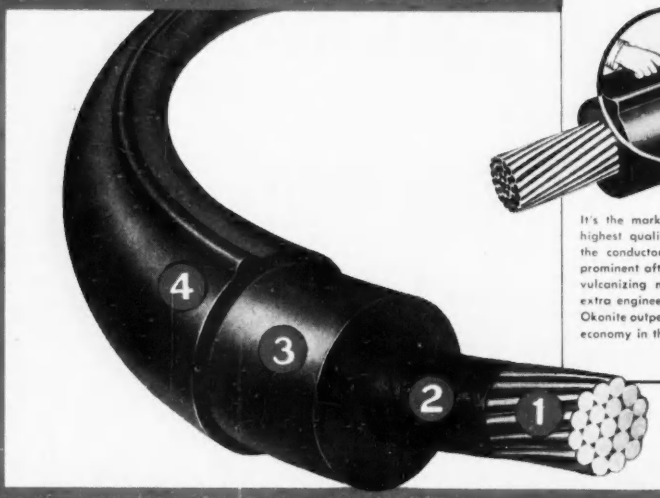
A CLUE TO LIFETIME CABLE VALUE



Look for this ridge and you find a reason . . .

It's the mark of an Okonite cable, proof that highest quality insulation has been applied to the conductor by Okonite's strip process. Still prominent after removal of the continuous metal vulcanizing mold, this ridge symbolizes many extra engineering features built-in to make sure Okonite outperforms ordinary cables . . . offers true economy in these days of high installation costs.

HERE, FOR EXAMPLE, IS A CABLE THAT'S PROTECTED 4 WAYS

It is a cable with a long and extensive service record. It is an Okolite-Okoprene cable with extra protection from conductor coating to sheath. It passes, in addition to a-c tests, high voltage d-c tests more severe than those required by any other manufacturer.

Into four different parts of this cable, extra service life is built . . . *at the conductor* (1) by a coating of Okoloy, a special corrosion-resistant lead alloy that outlasts tinning 2 to 1 . . . *about the conductor* (2) where an application of Semicon tape — on all Okolite-Okoprene cables operating at over 2000 volts — eliminates internal corona cutting and increases dielectric strength.

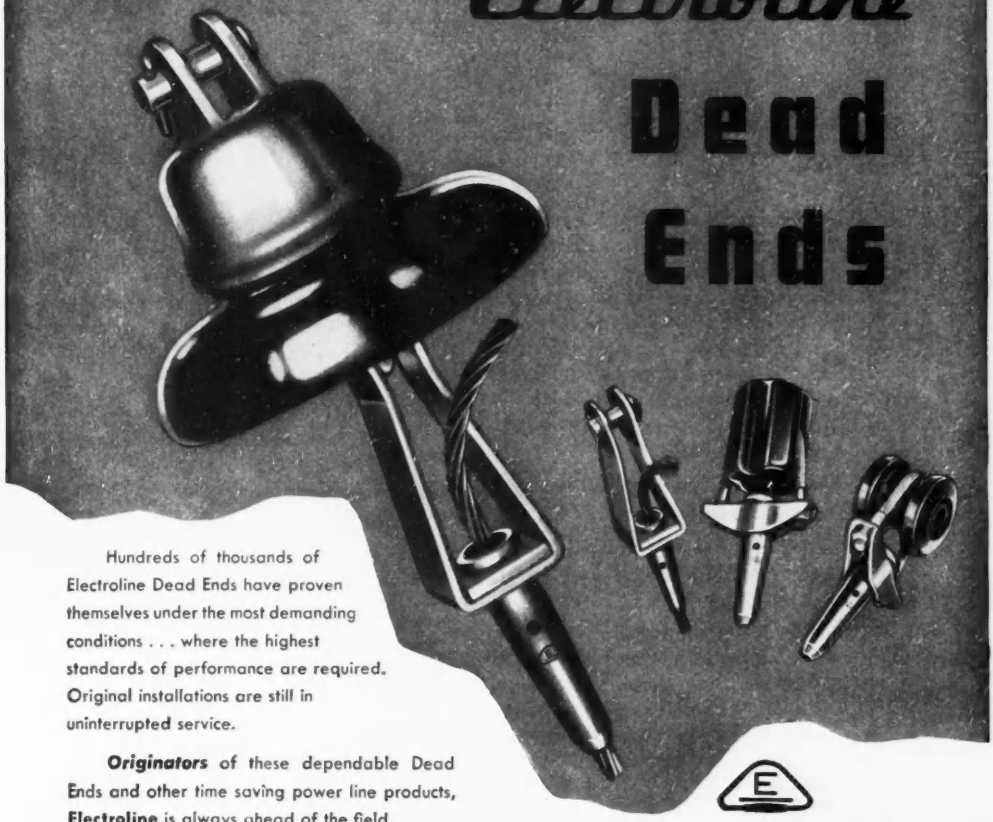
True cable value is added *by the insulation* (3) which is moisture-resisting, high-voltage Okolite made with Up-River Fine Para Rubber, the best grade of natural rubber. Okolite, an oil base insulation, has been proved in over 20 years of service, and is approved by Underwriters' Laboratories, Inc. as Type RWSN. *The outer sheath* (4) is Okoprene, the pioneer neoprene cable covering developed in the Okonite laboratories. Its life-extending durability and stable characteristics have been demonstrated on millions of feet of cable installed during the last 14 years.

Okolite-Okoprene cables possess many advantages from the standpoints of installation, electrical operation and design. These, along with dimensions and other data, are combined in an illustrated Bulletin EW-1037. For a copy, address The Okonite Company, Passaic, New Jersey.

THE BEST CABLE IS YOUR BEST POLICY

OKONITE OKONITE SINCE 1878 *insulated wires and cables*

The Records Prove the Performance of *Electroline* Dead Ends

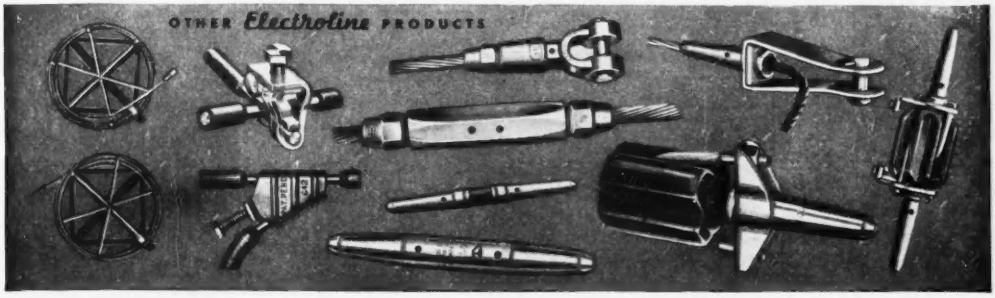


Hundreds of thousands of Electroline Dead Ends have proven themselves under the most demanding conditions . . . where the highest standards of performance are required. Original installations are still in uninterrupted service.

Originators of these dependable Dead Ends and other time saving power line products, **Electroline** is always ahead of the field —first with worthwhile improvements. Bulletins sent on request.

Electroline Company

4121 SOUTH LA SALLE STREET • CHICAGO 9, ILLINOIS



5 of the 8 LARGEST Utilities *Have Already*

The Positect is a "3-in-1" protective unit of unique and superior character. As a distribution cutout it tops the list in interrupting capacity and dependability. But the new Positect is more than a cutout, since it embodies safety and convenience features of great importance, not heretofore expected of any cutout.—And it provides these features at a cost so low that it permits widespread use—even standardization for the entire system.

Here enumerated are the features that make the Positect outstanding:

(1) SHORT CIRCUIT INTERRUPTING ABILITY

- Up to 12,000 RMS amperes—the highest of any cutout.
- Invulnerability to corrosion, vibration, and interference from ice, bugs or birds; adequate mechanical strength and high flashover values exceeding NEMA standards by up to 60%—all of which tend to assure highest interrupting ability at all times.

(2) SWITCHING CONVENIENCE

- Insertion or withdrawal of handle-and-tube is all that is necessary for switching distribution transformer load or magnetizing currents, or charging currents of small capacitor banks.

(3) SAFETY CHARACTERISTICS

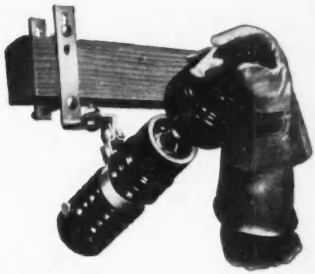
- Removes the hazard attending the inadvertent opening of conventional cutouts under load.
- Discharge is away from the man if accidentally closed in on short circuit.
- All live parts are unusually well enclosed.
- High interrupting ability gives adequate margin of safety against cutout "blowing up".

These features make the Positect particularly desirable for application on metropolitan distribution systems where concentratian of power is a general condition; for the areas of any system where power is concentrated; and for the growing areas where ultimately load concentration will bring about excessively high short circuit currents.

The fact that 5 of the 8 largest electric utilities have already adopted the Positect may be significant that it is a product meriting *your* most serious consideration. Ask for Catalog Section 520 telling more of the story.

S&C ELECTRIC

Adopted the NEW POSITECT



TYPICAL PERFORMANCE VALUES

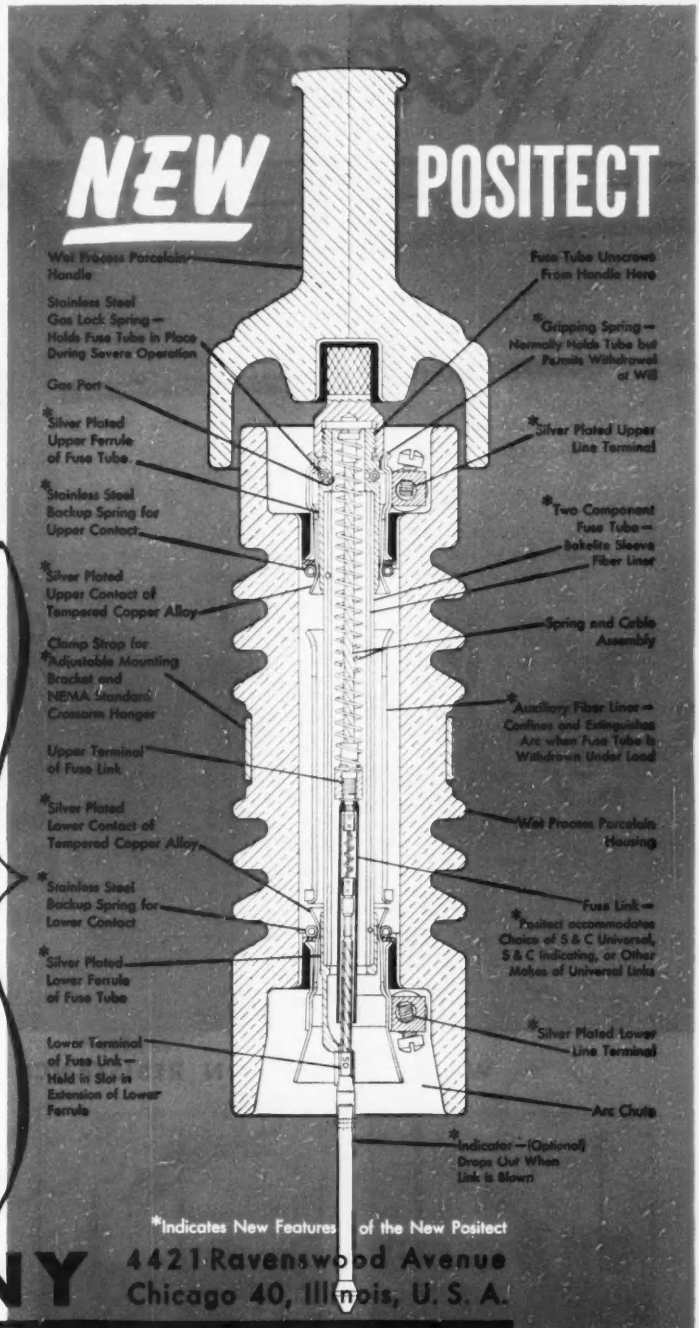
Short Circuit Interrupting Capacity
of 10,000 and 12,000 amperes for the 50-ampere and 100-ampere Positect respectively, on 2400-, 2400/4160y- and 4800-volt systems.

Load and Magnetizing Current Interrupting Ability
adequate for switching: 75 kva single-phase distribution transformers on 2400- and 2400/4160y-volt systems, with the 50-ampere Positect; 100 kva single-phase, with the 100-ampere Positect; also 3-phase transformers of corresponding load current values.

Charging Current Interrupting Ability
adequate for switching 3-phase capacitor banks up to 135 kvar on 2400-volt systems, and 225 kvar on 2400/4160y-volt systems, with 50-ampere Positect; with the 100-ampere Positect, 225 kvar on 2400-volt systems.

RATINGS

5000 Volts, 50 Amperes
5000 Volts, 100 Amperes
7500 Volts, 50 Amperes


Wet Process Porcelain Handle
Stainless Steel Gas Lock Spring — Holds Fuse Tube in Place During Severe Operation
Gas Port
*Silver Plated Upper Ferrule of Fuse Tube
*Stainless Steel Backup Spring for Upper Contact
*Silver Plated Upper Contact of Tempered Copper Alloy
Clamp Strap for *Adjustable Mounting Bracket and NEMA Standard Crossarm Hanger
Upper Terminal of Fuse Link
*Silver Plated Lower Contact of Tempered Copper Alloy
*Stainless Steel Backup Spring for Lower Contact
*Silver Plated Lower Ferrule of Fuse Tube
Lower Terminal of Fuse Link — Held in Slot in Extension of Lower Ferrule
Fuse Tube Unscrews From Handle Here
*Gripping Spring — Normally Holds Tube but Permits Withdrawal at Will
*Silver Plated Upper Line Terminal
*Two Component Fuse Tube — Bakelite Sleeve Fiber Liner
Spring and Cable Assembly
*Auxiliary Fiber Liner — Confines and Extinguishes Arc when Fuse Tube is Withdrawn Under Load
Wet Process Porcelain Housing
Fuse Link — *Positect accommodates Choice of S & C Universal, S & C Indicating, or Other Makes of Universal Links
*Silver Plated Lower Line Terminal
Arc Chute
*Indicator — (Optional) Drops Out When Link is Blown

*Indicates New Features of the New Positect

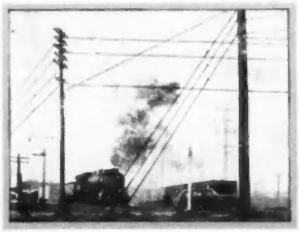
COMPANY

4421 Ravenswood Avenue
Chicago 40, Illinois, U. S. A.

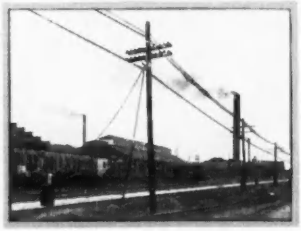
Formerly SCHWEITZER & CONRAD, INC.

Once they're Up--

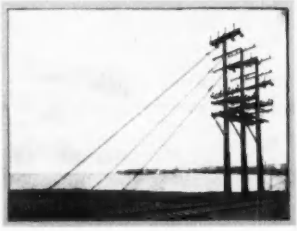
WHERE CORROSION RESISTANCE COUNTS!



Along Railroads



In Industrial Atmospheres



Along the Shore

In areas like these, where rust quickly weakens ordinary strand, you can rely on Copperweld Strand for long, dependable and economical service. Its thick protective copper armor resists fumes, smoke, cinders, moisture and other corrosive agents.

- they're Up to Stay!

COPPERWELD GUYS AND MESSENGERS ELIMINATE COSTLY REPLACEMENTS

You can be sure that your guys and messengers will last as long as your overhead lines, when you use Copperweld* Non-Rusting Strand. Thousands of companies have saved money—eliminated costly replacements—by standardizing on Copperweld Guys and Messengers—not only in extremely corrosive areas—but all along their lines.

Why does Copperweld Strand give long, trouble-free life—permanent high-strength—greater durability in service? It's because each wire consists of a strong alloy steel core permanently protected against rust by a thick molten-welded covering of copper. It's the special alloy steel that provides the rugged strength so necessary for dependable guys and messengers. And—it's the thick, non-rusting copper covering, protecting the steel, that makes Copperweld's original high tensile strength a permanent strength. You don't need to buy oversized strand as a precaution against later loss of strength due to rust and consequently you save by buying smaller diameters—fewer pounds.

Copperweld Strand is easy to handle. Strong, yet flexible and pliable—it can be readily bent, served, moused or clamped. The natural ductility of the thick copper covering and the strength of the molten-weld eliminate danger of cracking, flaking or peeling.

When you sum up all these practical advantages, we feel sure that you will give serious consideration to the use of Copperweld Strand for all your guys and messengers.

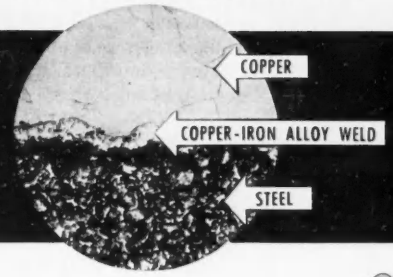
One of our engineers will gladly discuss this subject with you, upon request. Also, write for our Engineering Data Bulletins E. D. 1662 and E. D. 1686.

COPPERWELD STEEL COMPANY, *Glassport, Pa.*

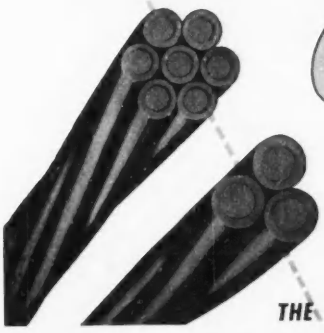
SALES OFFICES IN PRINCIPAL CITIES

Trade Mark

Each Copperweld Wire has a thick, non-rusting Copper Covering inseparably Molten-Welded to a strong Alloy Steel Core.



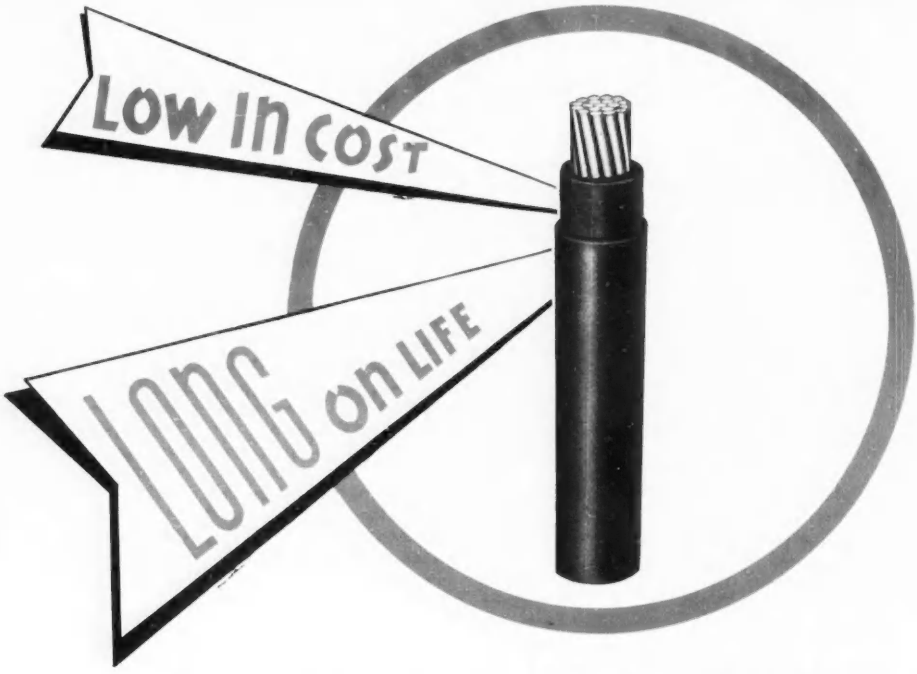
Photomicrograph of weld section. Note how the crystals of Copper and Steel interlock to form a permanent, continuous weld.



Copperweld
TRADE MARK

NON-RUSTING **GUY AND MESSENGER STRAND**

THE RUGGED STRENGTH OF STEEL plus THE PERMANENCE OF COPPER



Low in cost, long on life. That's the simple story of ANHYDROPRENE Wires. And those are the reasons why it pays to remember ANHYDROPRENE whenever you're planning new transmission and distribution systems, or are preparing to rewire those already in use.

ANHYDROPRENE Wires consist only of conductor, the famous Anhydrex insulation, and a thin, but tough, neoprene jacket. On some of the large sizes a tape is inserted between insulation and jacket. This simple construction establishes low purchase cost and produces a small-diameter, lightweight wire that's inexpensive to install.

ANHYDROPRENE construction also provides sound electrical and physical properties. There's the low water absorption and high dielectric strength of Anhydrex insulation. There's the resistance to abrasion, acids, corrosive chemicals, heat, light and flame of the neoprene jacket. At 8000 volts and under, ANHYDROPRENE Wires can be operated at copper temperatures as high as 75°C. These features assure trouble-free service year after year, even under unfavorable conditions. And long, trouble-free service means low installation costs and infrequent replacements.

ANHYDROPRENE Wires can be racked on walls and installed underground in ducts. You'll find them especially dependable for plant and shop wiring; for instrument wiring; as underground primaries, transformer leads, and pole line risers; and in signal and control circuits.

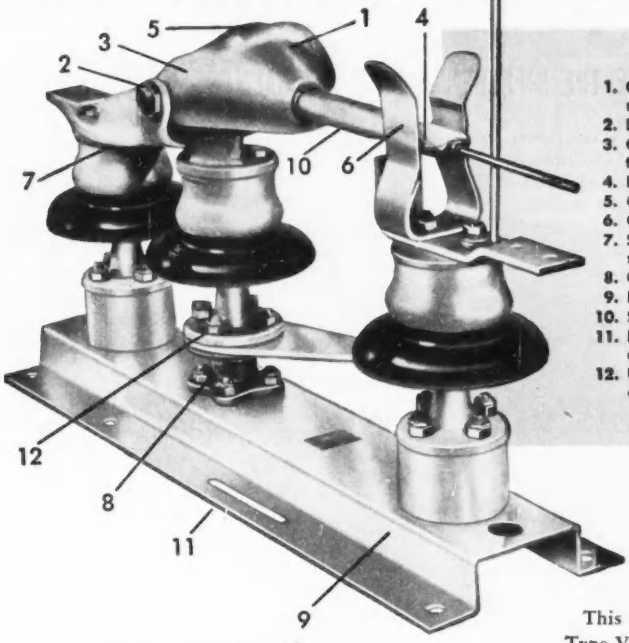
Simplex

WIRES & CABLES

SIMPLEX WIRE & CABLE CO., 79 SIDNEY ST., CAMBRIDGE 39, MASS.

YOU CAN BE **SURE**.. IF IT'S

Westinghouse



1. Completely-enclosed hinge-end mechanism.
2. Live-side bearings, lubricated for life.
3. Completely-enclosed solid bridging contact at hinge end.
4. High-pressure line contacts.
5. Only three moving parts.
6. One-piece break jaw.
7. Simplified and enclosed counterbalancing spring.
8. Greaseless, rotating insulator bearing
9. High-strength, bent-plate steel base.
10. Single tube blade.
11. Flat mounting surface with no downward extensions.
12. Universal operating mechanism for group operation.

LOOK CLOSELY!

Do your disconnecting switches have these features?

Check the above features closely. Each one *alone* means a better switch for your money. Install the Westinghouse Type V and you get them *all*.

This combination of vital features makes the Type V the leader of the switch field in dependability, economy and low maintenance. Get the benefits of experience and top-grade switch design in *your* system. Install the Westinghouse Type V.

For complete information on the Type V, or on the entire Westinghouse switch family, get in touch with your nearby Westinghouse office or distributor. Ask for B-4241 and B-4242. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-60699

Westinghouse
TYPE V
DISCONNECTING SWITCHES

6 Ways to Look

IMPORTANT DETAILS MAKE THE DIFFERENCE IN ALLIS-CHALMERS UNIT SUBS

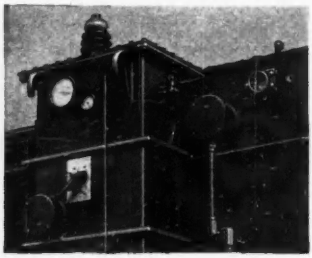
MANY DETAIL IMPROVEMENTS in unit substations have been pioneered by Allis-Chalmers: controlled gasket compression, protective *Oil-Sealed* inert gas system, "quick-break" contact separation, finger-type disconnects, no-corona taped bus joints, flexible drop collar throat, and others.

Together such improvements make up the real difference between superior and average performance. They are good points to look for, and compare, when purchasing unit substations for your distribution system.

±10% Regulation Results in Added Savings

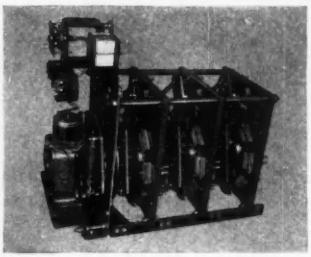
Allis-Chalmers unit substations cost less because of standardization on one range. This reduces your cost because the savings in engineering and manufacturing have been passed along to you. ±10% range was chosen since it fits most utility requirements and permits more load than ±7½%.

Call in your nearby A-C representative and have him go over the advantages you get with Allis-Chalmers unit substations. Or write direct.



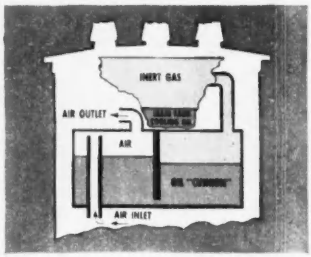
1. SAFETY

NO-LOAD TAP CHANGER on side of tank protects operator from accidental contact with overhead high voltage lines. Other safety features include: dead-front panels; interlocks; vertical lift breakers; drawout potential and control power transformers. Protects your operators, your equipment and your service.



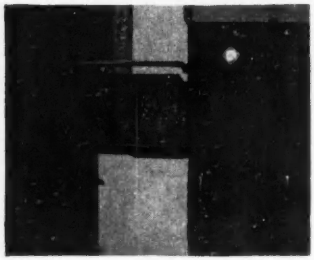
2. REGULATION

±10% RANGE is adequate for virtually any distribution substation. The narrow ⅝% steps of the tap-changing mechanism keep voltage fluctuations to a minimum. Oversize contacts and snap action minimize contact burning. Sturdy mechanism and motor operate in oil for maximum life.



3. MAINTENANCE

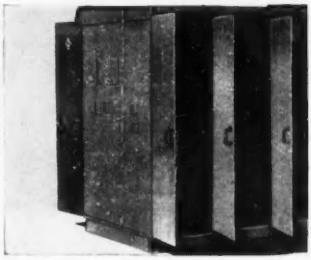
OIL-SEALED inert gas system uses no valves or external gas supply — reduces maintenance to routine gage readings. There are no external gas bottles to replenish, no waste gas. This system operates at pressures usually less than a pound . . . minimizing chance for gas leakage through gasketed joints.



4. INSTALLATION

DROP COLLAR throat saves time and money in preparing foundations. There is no need for exact alignment between transformer and switchgear because flexible connectors are used.

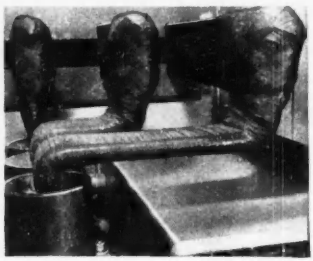
Switchgear units are shipped in groups as large as can be conveniently handled at the installation site.



5. ACCESSIBILITY

SWITCHGEAR HOUSING has doors front and rear permitting easy access to breakers; current, potential and control transformers; fuses.

Feather-Touch control for tap changer is in accessible cabinet. A transparent plastic cover for the voltage integrator permits inspection without breaking dust-tight seal.



6. FLEXIBILITY

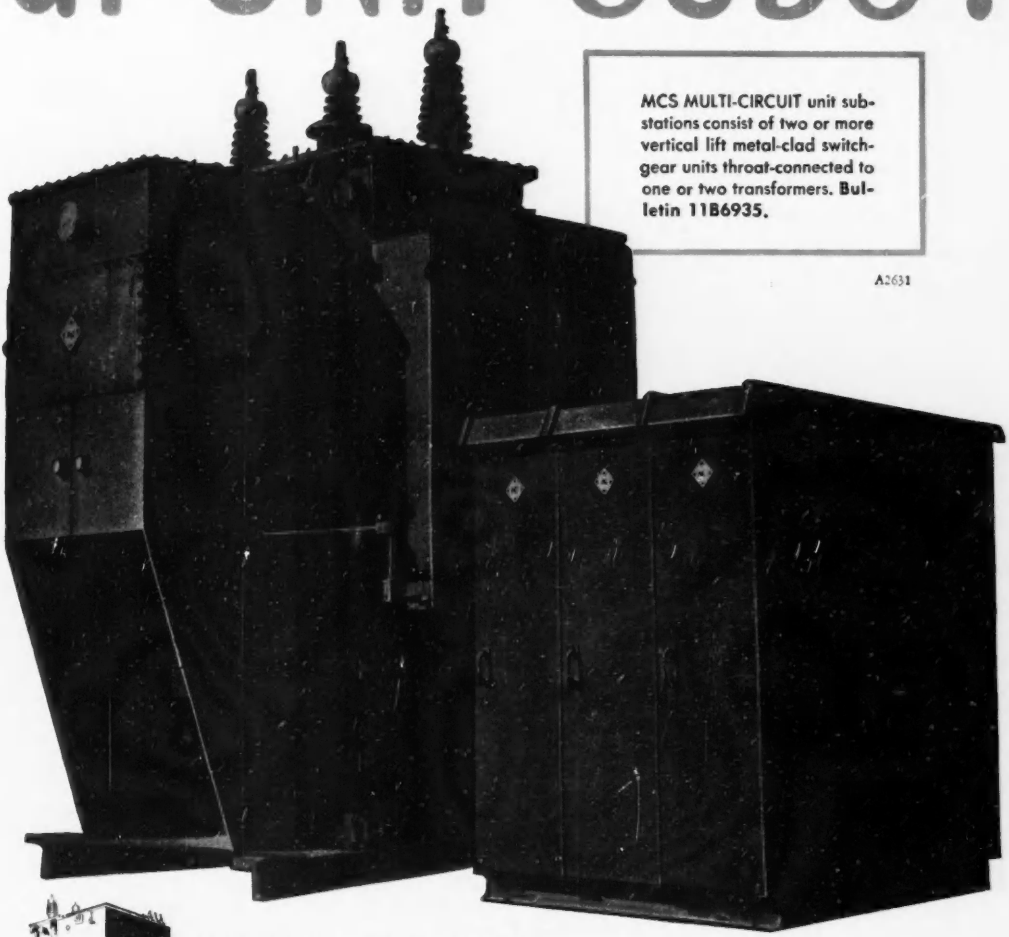
TAPED AND BOLTED connections reduce time and trouble involved in changing connections. No time is lost preparing compound in the field or filling connection boxes.

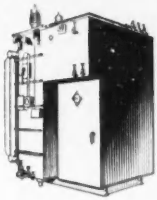
Standardized construction simplifies the addition of new switchgear units when more circuits are needed.

at UNIT SUBS!

MCS MULTI-CIRCUIT unit substations consist of two or more vertical lift metal-clad switchgear units throat-connected to one or two transformers. Bulletin 11B6935.

A2631





ALLIS-CHALMERS SCS SINGLE CIRCUIT unit substations consist of a transformer, secondary breaker and control, *Oil-Sealed* inert gas system for protecting oil, and the 32 5/8% step regulator mechanism for ±10% range of regulation — all combined within a single housing. They can be installed as a unit.

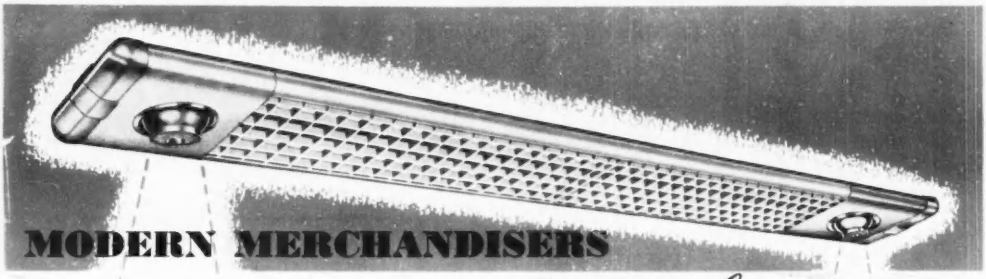
ALLIS-CHALMERS, 932A SO. 70 ST. MILWAUKEE, WIS.

Feather-Touch and *Oil-Sealed* are Allis-Chalmers trademarks

A-C ALLIS-CHALMERS

ALLIS-CHALMERS

Pioneers in Load Ratio Control — Originators of 5/8% Step Regulation



MODERN MERCHANDISERS

sell from the ceiling...

with this arch flatterer of products on display

Leader Fluorescent SPOTLINE

● Architects, lighting engineers, store designers, builders, and merchandisers all say Aye! to LEADER "eyes"—the powerful spotlights that dramatize merchandise so alluringly.

Yes, the new, inverted formula for sales success is to begin at the top and work down! To this end we invite YOU to install your star salesmen in the ceiling. Cash registers are proving the soundness of this advice: Hire LEADER Fluorescent SPOTLINES to put new pep into profits without adding a penny to the pay-roll.

NEW!
75 Watt
New Horizon Series

Features the new T-12, 75 watt tube. A very important addition to the Leader New Horizon line. 425 milliampere operation. Increases light output in offices, stores, schools, etc. Underwriters' Laboratories approved. Available in 2-lamp (NHC 280-F), 4-lamp (NHC 480-F) and 6-lamp (NHC 680-F) units. A marked advance in lamp performance. Write for full information.

SPECIFICATIONS:

LEADER SPOTLINE: A combination of Leader "New Horizon" Slimline fixtures fitted with Leader "Direclite" spotlights. Direclites are adjustable for lighting angles and are fitted between fixtures in continuous runs. For complete details see Page 7 of the new, 1949 Leader catalog.

Sold and installed only by the better electrical wholesalers and contractors.

A STEP AHEAD
LEADER
ELECTRIC COMPANY

Send for Complete Details

LEADER ELECTRIC COMPANY

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West Coast Factory: 2040 Livingston Street, Oakland 6, California

PACIFIC ELECTRIC
BUS FITTINGS
and BUS SUPPORTS

Made by Specialists in the Manufacture of High-Voltage Oil Circuit Breakers and Air Switches

VEX

VKA

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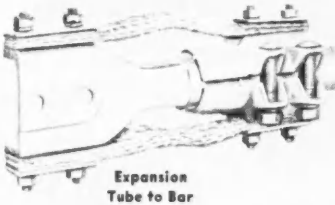

Expansion Tube to Bar

Pacific Electric Features*

Cast to Size . . .
To insure highest conductivity when applied to tubes having the usual variation of diameter within tube-manufacturer's tolerance limits.

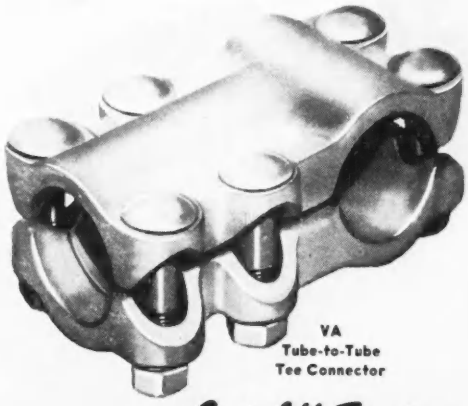
Bolts Cannot Drop Out During Installation . . .
Special retainers hold bolts firmly in caps.

Rounded Edges . . .
Reduce junction-fatigue failure.

One-Wrench Tightening . . .
Oval-shank bolts in oval holes prevent shank from turning.

Pressed-On Ferrules . . .
Expansion flexibles have precision-made ferrules applied under 60-tons pressure.

*Applying to most designs of copper-alloy fittings; those for aluminum conductor differ slightly.


VA
Tube-to-Tube Tee Connector

20,000-amp Terminal for Low-Voltage Electrolytic Installation

Stud to Cable

Just Off the Press:
Ask for new Catalog 710 . . . 28 pages of specifications and dimensioned illustrations of Pacific Standard-Line of Bus Fittings and Supports.

Get All Facts . . .

Call

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KRIPPNER and POLLEY, 1 Downing St., Denver 9, Colo.
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Other Representatives in Principal Cities

Now here's a Connector!!!

It's a Servit. We might call it a split-bolt, a "bug" or even a BURNDY. Mister, I call it a *real* connector.

I can't begin to remember how many thousands I've used. One thing sure—they make my job easier.

If I'm making a tap or a service connection just give me a SERVIT and a wrench.

If you're a "Doubting Thomas" try them . . . see for yourself how SERVITS save and serve!

Connect with

BURNDY

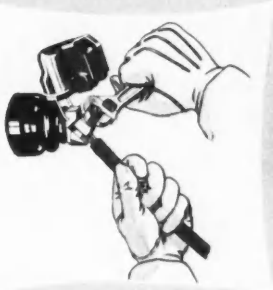
New York 54, N. Y.

WESTERN BRANCH: Vernon 21, California

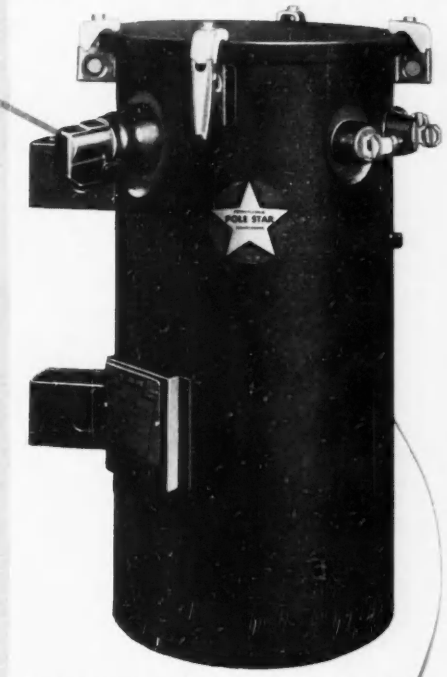
CANADA: Canadian Line Materials, Ltd., Toronto 13

NO POCKETS
ON THE
POLE STAR

Terminals receive line leads at the same angle as pocket-type bushings. Solderless connectors are forged of naval brass to assure a rugged connector of uniform strength. Heavy bakelite insulating caps are secured to the solderless connectors by spring wire hinges.



Caps are self-supporting above the terminals. Line connections are made with a standard wrench. Solderless connectors are completely exposed so lineman can see the connection he is making. Caps are closed by hand pressure and completely cover bushing terminals.



Embodying a new wound core design with an inherent low exciting current, Pole Star Transformers are made in sizes 25 Kva and below, 14400 volts and below, single phase, 60 cycles, OA, conforming to E.E.I.-NEMA Standards. Will soon be available in sizes up to 100 Kva.

Years ago, when bushings were neither weatherproof nor leakproof, pockets and pocket bushings were required on Distribution Transformers. In designing the Pole Star Transformer, however, Pennsylvania Development Engineers replaced the high voltage pockets and pocket bushings with sturdy, streamlined sidewall bushings. This was done because today bushings are provided with stud-type terminals and gasket seals which insure pressure tight joints and sealed tank construction. This is another one of the modern improvements incorporated into the Pennsylvania Pole Star Transformer. It is another example of Pennsylvania's Engineering Ingenuity.

P. S. Let the Pole Star be your guide.

If you want to know more about the Pole Star Transformer, write to us for Catalog No. 349.

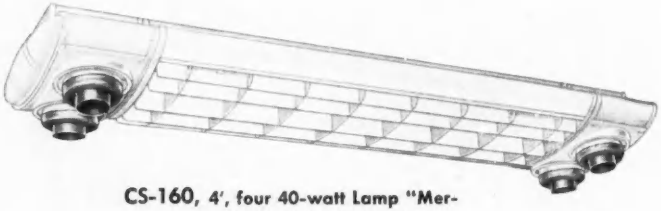
Pennsylvania
TRANSFORMER COMPANY
PITTSBURGH, 12, PENNSYLVANIA

YOU CAN BE **SURE**.. IF IT'S

Westinghouse

CS-276, 8', four 96" Slimline Lamp "Merchandiser" with 2SS-150 Spotlights

CS-170, 5', two 85-watt Lamp "Merchandiser" with 2SS-150 Spotlights



CS-160, 4', four 40-watt Lamp "Merchandiser" with 2SS-150 Spotlights

2SS-150, for Two PAR-38 Spot or Flood Lamp

CS-80, 4', two 40-watt Lamp "Merchandiser" with SS-150 Spotlights

SS-150, for One PAR-38 Spot or Flood Lamp

THE MERCHANDISERS

. . . Standard Units That Provide

"CUSTOM LIGHTING" FOR ANY STORE

Flexibility of Installation — The "Merchandisers" provide greatest flexibility to meet varying conditions. The different sizes and types are shown at left. Both the fluorescent and incandescent sections may be used individually, in groups, or in continuous rows. Spotlights may be combined with fluorescent sections in whatever arrangement is most suitable for your customers' needs. Swiveling feature permits both horizontal and vertical adjustments.

Easy to Install and Maintain — The lightweight housing may be quickly attached on the ceiling. Then it's an easy job to hang the ballast and reflector assembly in place. Cleaning, too, is simplified because there is little space for dust and dirt to accumulate. The louver may be easily removed for an occasional bath and lamps are readily accessible for replacement or cleaning simply by swinging down the louver from either side.

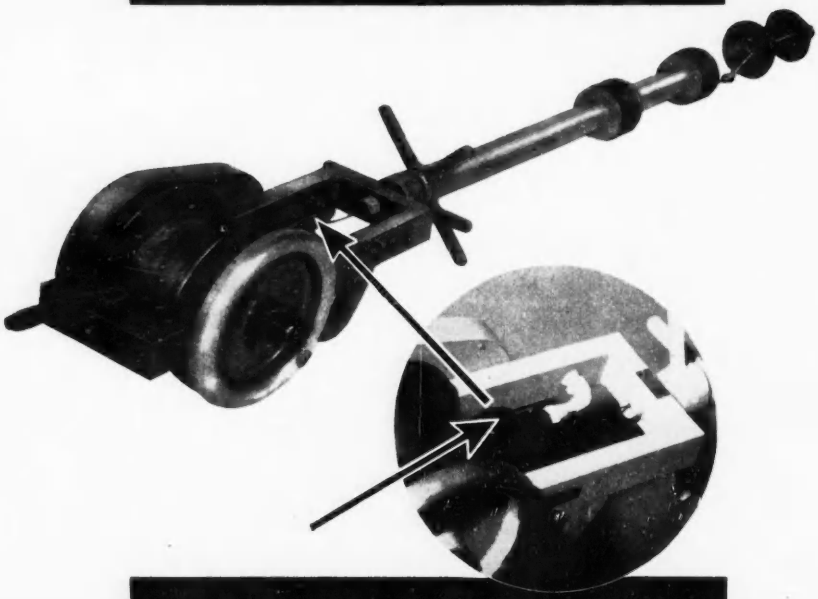
A Westinghouse Lighting Sales Engineer will gladly co-operate with you in planning lighting installations for your store customers. Call your local Westinghouse Distributor today. J-04219

Free booklet B-4076 tells story of how to light store areas with the "Merchandiser". Send for it today. No obligation, of course. Write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna.

Westinghouse

PLANNED LIGHTING PAYS

NOW! The COPE Pneumatic Fish Line Goes a Step Further!



The POWER REWIND enables you to CLEAN as well as ROD!

The COPE Pneumatic Fish Line now has an air powered rewind—a rewind with sufficient power to pull cleaning or testing tools in various combinations. Think of it—not only can you fish underground ducts in a matter of minutes—you can actually eliminate operations from your rodding procedure.

The feature of power rewind has been added to the COPE air operated duct rodding tool whose performance has been acclaimed by users in the United States, Canada, and other countries. Savings as great as 58 minutes of each rodding hour have been reported in rodding ducts of many sizes and lengths, some as large as 8" in diameter, and some as long as 1750 feet.

Write today for full details of this new tool—The COPE Pneumatic Fish Line.

T. J. COPE INC.

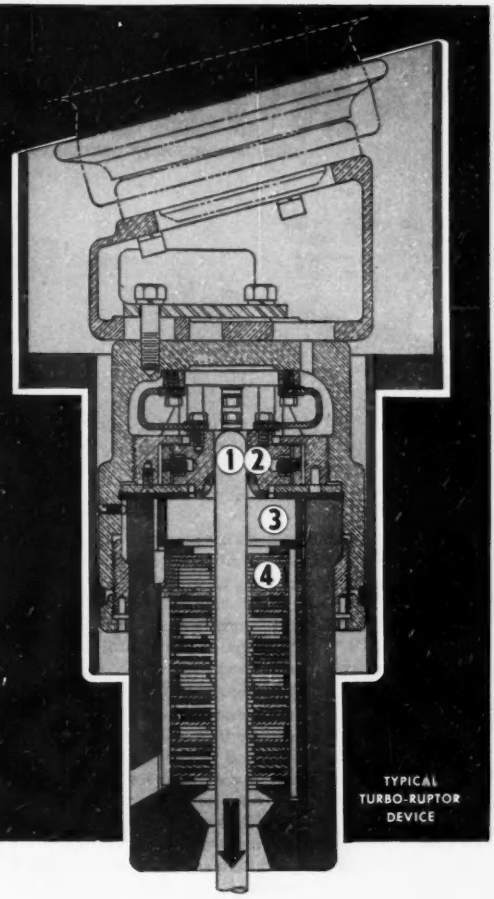
711 SOUTH 50th ST.
PHILADELPHIA 43, PA.

YOU KNOW COPE BY THESE PRODUCTS

How Arcs Speed Circuit Interruption

IN RUPTOR DEVICES

SIMPLIFIED DESIGN ASSURES HIGH-SPEED PERFORMANCE WITH SHORT ARCING TIME



TYPICAL TURBO-RUPTOR DEVICE

WHEN BAYONET contact (1) drops from the stationary contact (2), an arc is initiated in the oil-filled pressure chamber (3). Pressure from the gas generated by the arc causes the oil to swirl down dual helical throat passages (4). These restricted, converging passages force jets of oil into the elongating arc and against the moving bayonet arcing-tip. This turbulent action disperses the arc and waste products, completing interruption at an early current zero.

The simplified *Ruptor* interrupting device has no moving parts to bind or fail. Stationary contact segments provide self-wiping, high pressure contact with the movable bayonet — for low resistance and low temperature rise.

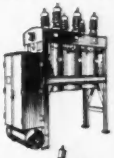
Check with your nearby A-C representative for the complete story of this feature . . . and others of Allis-Chalmers oil circuit breakers — in ratings to meet all your needs. Or write direct. A-2680

Ruptor and *Turbo-Ruptor* are Allis-Chalmers trademarks.

ALLIS-CHALMERS, 932A SO. 70 ST.
MILWAUKEE, WIS.

RUPTOR OR TURBO-RUPTOR DEVICES ARE USED ON THESE ALLIS-CHALMERS OUTDOOR OIL CIRCUIT BREAKERS

TYPE BZO-160 . . . 69 kv to 230 kv — 5-cycle opening, 20-cycle reclosing.



TYPE FZO-150 . . . 14.4 kv to 46 kv — 8-cycle opening, 20-cycle reclosing

TYPE FZO-151 . . . 69 kv — 5- or 8-cycle opening, 20-cycle reclosing

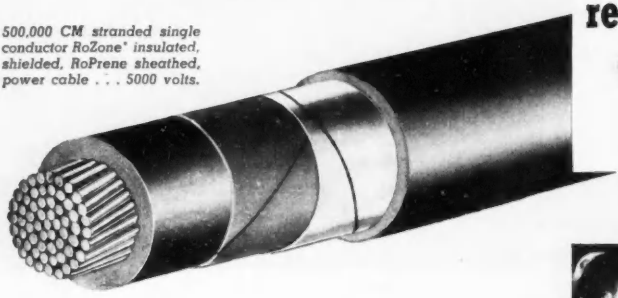
TYPE O . . . 14.4 kv to 23 kv—8-cycle opening, 35-cycle reclosing

ALLIS-CHALMERS

Pioneers in Power and Electrical Equipment From Generation Through Utilization

RoZone*

Rome's ozone-resistant insulation that surpasses specifications



500,000 CM stranded single conductor RoZone insulated, shielded, RoPrene sheathed, power cable . . . 5000 volts.*

RoZone*, an oil-base, ozone-resistant insulating compound, can be depended upon for service performance "above and beyond the call of duty" . . . a *plus* value assured by *plus* quality controls. In maintaining RoZone's high standard of quality there can be no half-way measures. That is why Rome Cable control of quality goes *beyond* specification test requirements . . . to make certain that every length of RoZone* insulated cable possesses that *plus* quality for dependable long cable life.

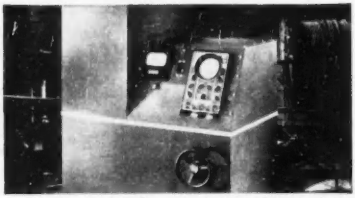
High electrical stability in wet locations, immunity to the effects of corona and ozone, high dielectric and surge strength, and low dielectric loss, place RoZone* in an unexcelled position for higher voltage applications. For circuits of 8000 volts, or less between phases, at operating temperatures up to 75° C, RoZone* will give you a new conception of cable performance.

RoZone* insulated cables can be supplied with or without electrostatic shieldings and are manufactured with RoPrene (Neoprene) sheath or other conventional cable coverings as specified. RoZone* is particularly recommended for series street lighting and power distribution circuits; motor, generator and transformer leads; as well as station control and other general purpose wiring where high quality is paramount.

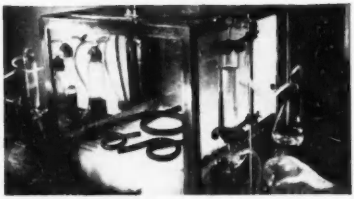
For complete engineering data write for your copy of Specification RO-4.

*TRADEMARK REGISTERED

Moisture resistance of insulated cable specimens is measured electrically in long time immersion tests.



Corona level of RoZone insulated cables is determined by means of this equipment.



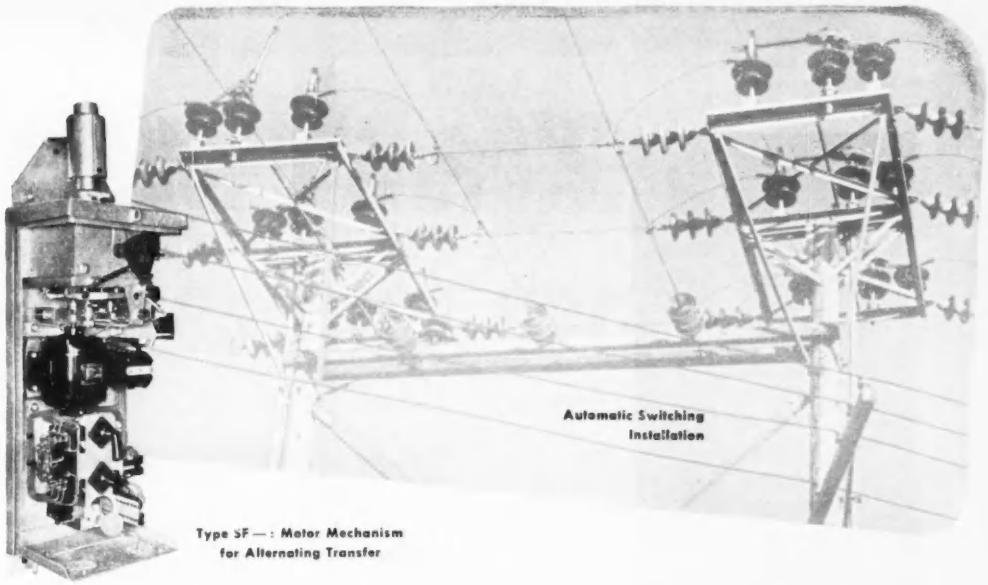
RoZone's resistance to ozone cutting is determined by exposing specimens to ozone atmosphere.

FROM BAR TO FINISHED WIRE

ROME CABLE CORPORATION

ROME • NEW YORK

ROME CABLE ROME, N.Y.



Automatic Switching Installation

Type SF — : Motor Mechanism for Alternating Transfer

AUTOMATIC SWITCHING WITH AIR SWITCHES

PRACTICAL — ECONOMICAL — BROADLY APPLICABLE

Maximum economy of equipment is obtained by using DELTA-STAR motor operated air-switches for automatic isolation of a fault or transferring of a load in event of a line failure.

Automatic switching can be divided into two groups: transfer schemes and sectionalizing schemes.

Transfer schemes normally use two motor-operated air switches electrically interlocked to provide automatic selection from two power sources. The basic arrangements of transfer schemes are: (1) alternating transfer, with switches automatically selecting the live line on loss of voltage; (2) preferred emergency, with the preferred line switch normally closed—voltage loss causes the preferred line switch to open and the emergency line switch to close and remain closed until the preferred line is again energized; (3) one way transfer, where preferred line switch opens on loss of voltage and emergency switch closes.

Sectionalizing schemes for use with radial feeders or loop circuits isolate faulted sections so service can be maintained on the remainder of the system. These schemes can be fully automatic and semi-automatic. In the former, switches are opened or closed after a time delay. In the semi-automatic scheme, switches are arranged for automatic opening and non-automatic closing.

Variations can be made to meet special requirements. Successive time delay features and synchronization checking relays can be included.

If you are planning a new installation or modernization of an existing distribution system, it will pay you to consider Delta-Star motor operated switches designed for automatic switching.

For a Complete description and circuit diagrams ask for Publication 4811.

DELTA-STAR ELECTRIC COMPANY

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NEW YORK OFFICE — 140 Cedar St., New York 6, N. Y.

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CANADIAN ASSOCIATE

Canadian Line Materials Limited ..... Toronto 13, Canada

NEW UTILITY STATIONS C-E EQUIPPED

Includes stations placed in operation since the war (in white) and those under construction or being engineered.

TIDD
JENNISON
CECIL LYNCH
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MEREDOSIA
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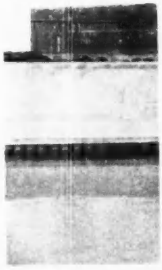
JIM HILL
DUNKIRK
TITUS
HUTCHINSON
TWIN CITIES
DALLAS
EDGE MOOR
YATES
CONTRA COSTA
LEE
CLERMONT

NEW

The new White River Generating Station of the Indianapolis Power & Light Company started operation in February when the first of four 40,000-kw preferred standard turbine-generators went into service. The second, duplicate unit is scheduled in the spring of 1950 and the third unit sometime in 1951.

The new station, designed and constructed by Gibbs & Hill, Inc., is located on the White River, 18 miles southwest of the Indianapolis city limits and 4 miles north of Martinsville, Indiana. It is part of the system serving the city of Indianapolis and adjacent territory.

Steam for this new capacity will be supplied by a C-E Generating Unit designed to produce continuously 400,000 lbs per hour at 875 psi and 900 F. A second C-E Unit, duplicate of this one, is now under construction. These units are virtual duplicates of the two that have been operating so successfully at the Harding Street Station of the Indianapolis Power & Light Company. B-304

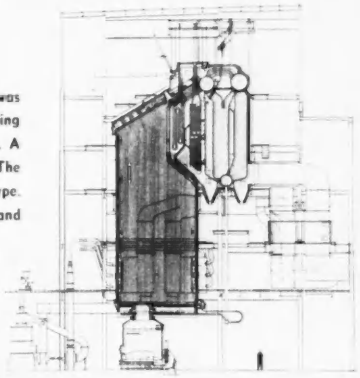


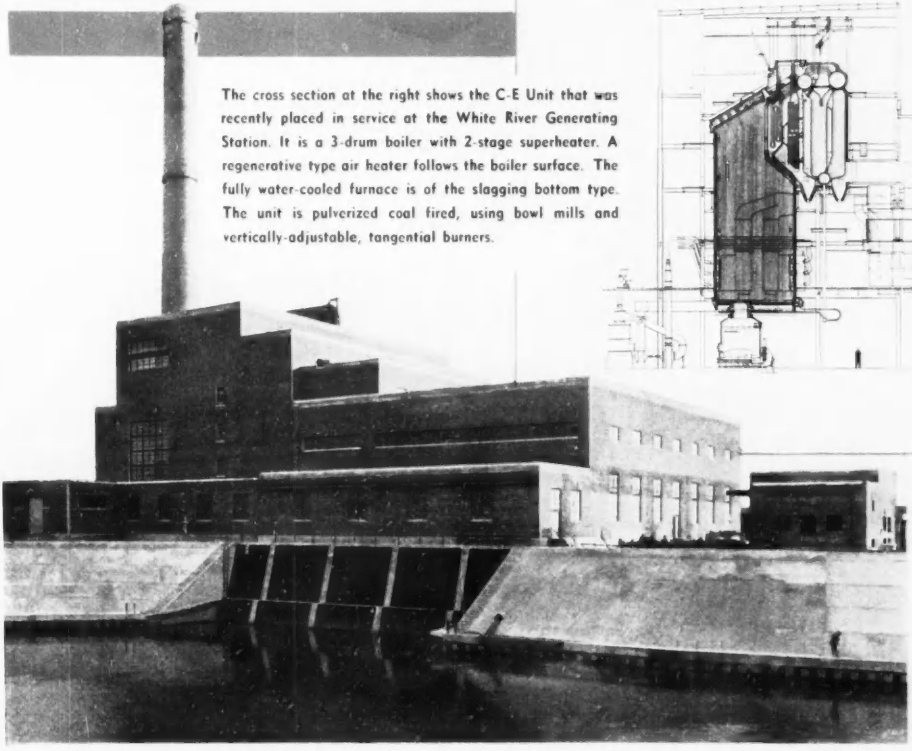
COMBUSTION ENGINEERING

A MERGER OF COMBUSTION ENGINEERING COMPANY, INC. AND THE SUPERHEATER COMPANY

White River Station goes into service

The cross section at the right shows the C-E Unit that was recently placed in service at the White River Generating Station. It is a 3-drum boiler with 2-stage superheater. A regenerative type air heater follows the boiler surface. The fully water-cooled furnace is of the slagging bottom type. The unit is pulverized coal fired, using bowl mills and vertically-adjustable, tangential burners.



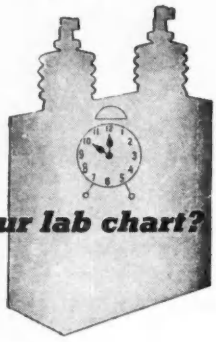


—SUPERHEATER, INC.

200 MADISON AVENUE, NEW YORK 16, N. Y.

C-E

how do you
select a capacitor for
dependability . . .



by a 10 hour lab chart?

or

a 10 year service report?

it's a fact
proved by actual use
for over 10 years!

cornell-dubilier capacitors for power-factor improvement

Standard 540 kva., 4,800 Volt, Delta Connected Substation Capacitor, With Breaker Compartment

Time is the surest of all capacitor test yardsticks. Not by hours — but by 10 years of field service as achieved by Cornell-Dubilier Capacitors wherever installed for power-factor improvement. Field service records of more than 3,500 major installations — over 800,000 kva. — offer you proof too that C-D is preferred for its long life and dependability in actual use. Call in a seasoned C-D engineer to analyze your power-factor requirements. Cornell-Dubilier Electric Corporation, Dept. D5-9 South Plainfield, New Jersey. Other plants in New Bedford, Worcester, Brookline, Massachusetts; and Providence, Rhode Island.

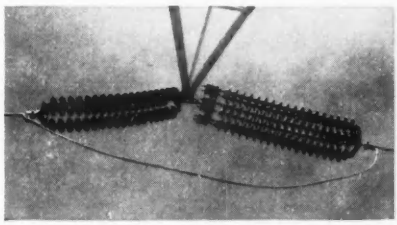
CORNELL-DUBILIER • WORLD'S LARGEST MANUFACTURER OF CAPACITORS

BTC

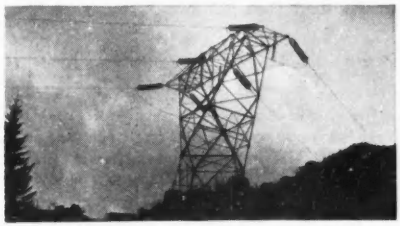
FORGED STEEL HI-LINE HARDWARE

Used on Another Important Transmission Line

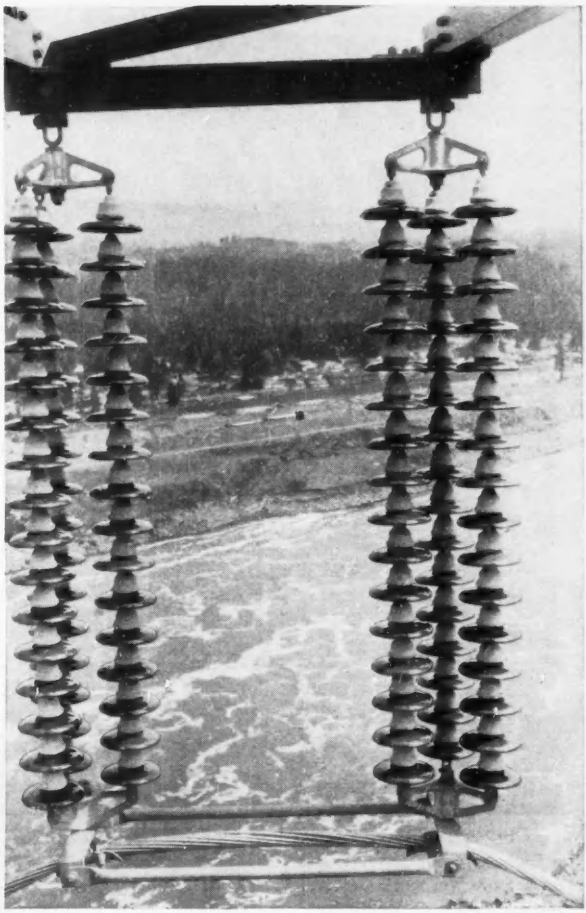
Sold only through your insulator manufacturer



Conductor dead-ending at Bradford Island Crossing was through Six-String Strain Yoke Sets using springs to equalize Insulator String tension. Triple Strain Yoke Sets were used on the inland side of towers.



One of the Dead-End Towers showing Triple Strain Yoke Sets and Jumper Suspension Strings.



The suspension construction at Bradford Island Crossing used two high strength forged steel clamps each connected to Yoked Triple Insulator Strings.

The Bonneville-Vancouver line is but one link in the Bonneville Power Administration's extensive transmission line network which has been an important factor in the development of the Pacific Northwest.

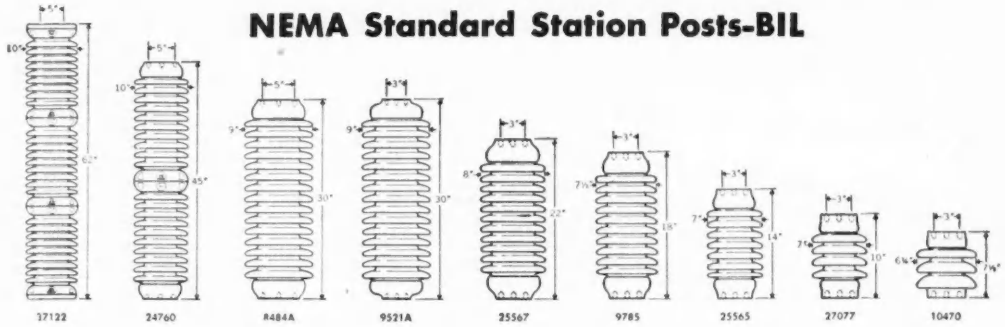
This 230 kv. line, built in 1939, is 35.6 miles long. The conductor, except for the river crossing described below, is 795,000 cm. A.C.S.R., supported, at 12750 pounds tension, on steel structures. At the Bradford Island Columbia River Crossing the special 801,900 cm. A.C.S.R., under 26,000 pounds tension, is suspended on high river-bank towers and dead-ended on next adjacent inland towers.

All Suspension Clamps, Strain Yoke Sets, and Fittings by BTC. Service record has been very satisfactory.

THE BREWER-TITCHENER CORPORATION, CORTLAND, NEW YORK

Announcing...

NEMA Standard Station Posts-BIL

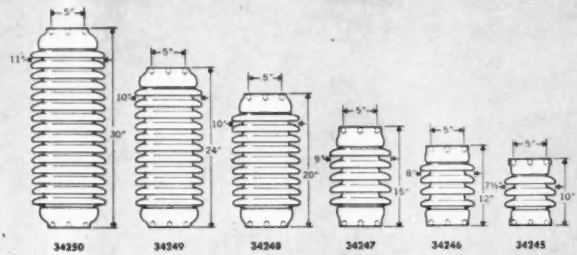


CATALOG NUMBER	37122	24760	8484A	9521A	25567	9785	25565	27077	10470
Rating, kv	161	115	69	69	46	34.5	23	15	7.5
Dry Flashover Voltage, kv	485	385	235	235	170	145	110	85	60
Wet Flashover Voltage, kv	380	285	180	180	125	100	75	55	40
Impulse Flashover Voltage, kv, Pos. 1.5 x 40	800	590	390	390	280	225	170	125	105
Impulse Flashover Voltage, kv, Neg. 1.5 x 40	1000	770	475	475	340	290	250	200	120
Leakage Distance, inches	132	99	72	72	43	37	24	15.5	10.5
Cantilever Strength, upright, lbs.	1200	1700	1500	1500	2000	2000	2000	2000	2000
Cantilever Strength, inverted, lbs.	1070	1470	1500	1500	2000	2000	2000	2000	2000
Tension Strength, lbs.	20000	20000	12000	12000	8000	7000	5000	5000	5000
Torsion Strength, inch-lbs.	40000	40000	15000	15000	12000	10000	8000	7000	6000

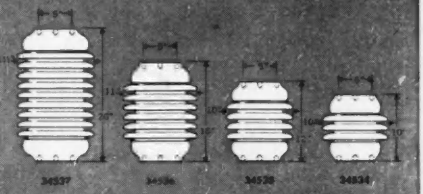
Now available for the first time as "catalog items" are Lapp Station Posts in complete series standardized in three strength ratings. These insulators are in accordance with BIL established values and meet NEMA standards. When you standardize on Lapp Station Posts for switch and bus support, you assure yourself insulators soundly engineered to every service requirement. Lapp NEMA Standard Station Posts, High-Strength Station Posts, Extra-High-Strength Station Posts, and a variety of special-purpose Station Posts, are listed, together with complete specifications, in the new Lapp Catalog No. Seven. If you have not received your copy, we will send it on request. Lapp Insulator Co., Inc., LeRoy, N. Y.

LAPP STATION POSTS IN 3 STRENGTH SERIES

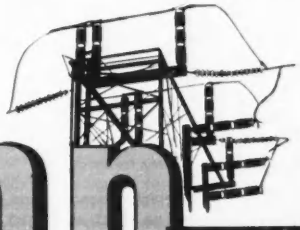
High-Strength Station Posts-BIL



Extra-High-Strength Station Posts-BIL



CATALOG NUMBER	34250	34249	34248	34247	34246	34245	34537	34536	34535	34534
Rating, kv	69	46	34.5	23	15	7.5	34.5	23	15	7.5
Dry Flashover Voltage	235	170	145	110	85	60	145	110	85	60
Wet Flashover Voltage	180	125	100	75	55	40	100	75	55	40
Impulse Flashover Voltage, kv, Pos. 1.5 x 40	390	280	225	170	125	105	225	170	125	105
Impulse Flashover Voltage, kv, Neg. 1.5 x 40	475	340	290	250	200	120	290	250	200	120
Leakage Distance, inches	72	43	37	24	15½	10½	37	24	15½	10½
Cantilever Strength, upright, lbs.	4000	4000	4000	4000	4000	4000	8000	8000	8000	8000
Cantilever Strength, inverted, lbs.	4000	4000	4000	4000	4000	4000	8000	8000	8000	8000
Tension Strength, lbs.	20000	15000	14000	10000	10000	10000	28000	20000	20000	20000
Torsion Strength, inch-lbs.	40000	20000	20000	16000	14000	12000	40000	32000	28000	24000



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CHEVROLET You'll discover a new kind of value when you drive and ride in these Advance-Design Chevrolet trucks. You'll find fleetness and flexibility, power and massive strength and long-lasting quality in every feature of body, frame, cab and chassis. Yet, you enjoy all these premiums *at lowest cost*, for Chevrolet trucks have 3-WAY THRIFT—low-cost operation, low-cost upkeep and the *lowest list prices in the entire truck field!*

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Chevrolet's 4-SPEED SYNCHRO-MESH TRANSMISSION offers quicker, quieter and easier operation in Series 3800 and heavier duty trucks. Faster shifting maintains speed and momentum on grades.

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Chevrolet's power-packed VALVE-IN-HEAD ENGINE provides improved durability and efficiency as well as the world's greatest economy for its size!

Chevrolet Advance-Design brings you the FLEXI-MOUNTED CAB, cushioned on rubber against road shocks, torsion and vibration.

Chevrolet's exclusive SPLINED REAR AXLE HUB CONNECTION adds greater strength and durability to heavy-duty models.

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**Heating and ventilating system and rear-corner windows with de luxe equipment optional at extra cost.*

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RUGGEDNESS "came naturally" in the development of R&IE Switches—because they were designed with a Margin of Quality.

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3. **BEARINGS**—designed for radial loads far exceeding switch requirements. Heavy galvanized housing, stainless ball bearings, with temperature-tested weather-seal.
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- SUBSTATIONS
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- KIRK INTERLOCK SYSTEMS
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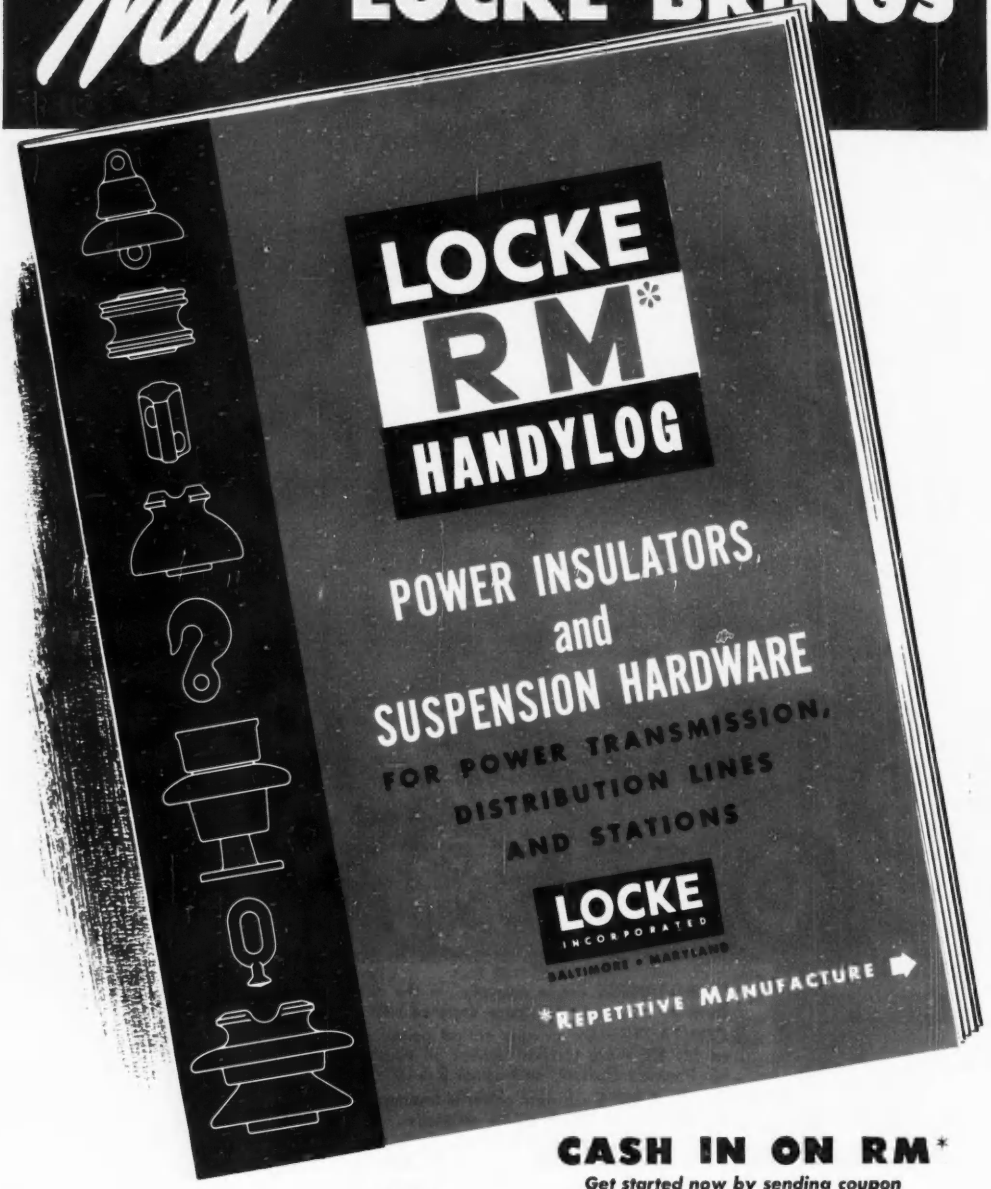

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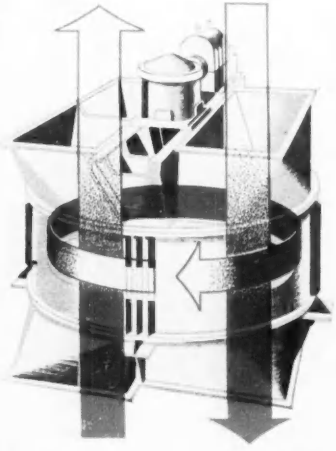
No. 3

The regenerative principle of heat exchange favors a high ratio of effective surface area to unit volume. In the Ljungstrom, this is accomplished by a compact arrangement of heat-transfer elements.

All the characteristics of the Ljungstrom's rotating heat-transfer unit—its surface area, size and shape of passages, and counter-flow arrangement—act to obtain maximum heat recovery for the unit's size and weight.

LJUNGSTROM



The Ljungstrom Air Preheater is a compact gas-to-air or gas-to-gas heat exchanger, operating on a continuous regenerative counterflow basis. Hundreds of leading power plants and other special applications confirm its high level of heat recovery and long-term low maintenance service.

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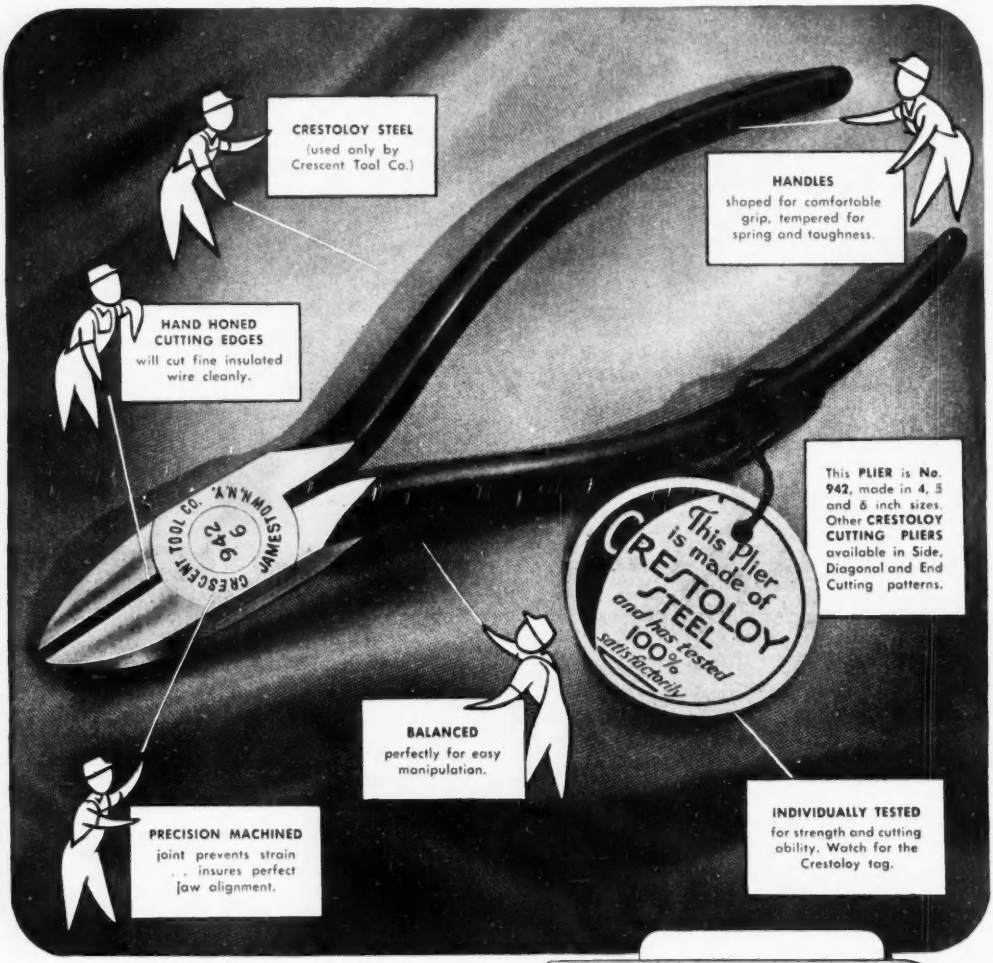
UNITED STATES STEEL

CRAFTSMEN RECOGNIZE QUALITY *by these fine features in* CUTTING PLIERS


CRESTOLOY STEEL
(used only by Crescent Tool Co.)
HANDLES
shaped for comfortable grip, tempered for spring and toughness.
HAND HONED CUTTING EDGES
will cut fine insulated wire cleanly.
CRESCENT TOOL CO. JAMESTOWN, N.Y. U.S.A. 9 942
This PLIER is No. 942, made in 4, 5 and 6 inch sizes. Other CRESTOLOY CUTTING PLIERS available in Side, Diagonal and End Cutting patterns.
This Plier is made of CRESTOLOY STEEL and has tested 100% satisfactorily
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perfectly for easy manipulation.
PRECISION MACHINED
joint prevents strain . . . insures perfect jaw alignment.
INDIVIDUALLY TESTED
for strength and cutting ability. Watch for the Crestoloy tag.

EVERYBODY RECOGNIZES QUALITY *by this Trade-mark*

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"Crescent" is our trade-mark, registered in the United States and abroad, for wrenches and other tools. Sold by leading distributors and retailers everywhere and made only by

CRESCENT TOOL COMPANY, JAMESTOWN, NEW YORK

PLP Dead-Ends* Save 3 Ways

- **THEY SAVE TIME**—Linemen can install PLP Dead-Ends in just a fraction of the time required for any other accepted method . . . and do a better job. No tools of any kind are required for the majority of installations. PLP Dead-Ends need no clamps, no time-consuming bolts and nuts.
- **THEY COST LESS**—PLP Dead-Ends are simply armor rods that are preformed in the Factory with such a pitch that when twisted together, they form a tight, uniform gripping sheath around the conductor or guy . . . either stranded or smooth. The resulting joint is at least 95% as strong as the conductor or guy wire.
- **THEY MINIMIZE MAINTENANCE**—Once on, these Dead-Ends are there to stay. There can be no loosening from vibration or other causes. The harder the pull, the tighter they grip. And there are no concentrated stresses to cause conductor failure. As a definite PLUS, they assure protection against chafing, arcover, pitting, burning and corrosion.

To learn more about PLP Dead-Ends, ask any salesman of American Steel and Wire Company, Locke Incorporated or Line Material Company. Or write directly to us.

*Protected under Patent No. 2,275,019

EASY TO APPLY

Simply slip one end of the PLP Dead-End through the strain insulator, insulator eye or clevis; position on the conductor or guy wire; and simply twist into place by a hand motion like "wringing a cloth". No tools are needed, no clamps for holding.

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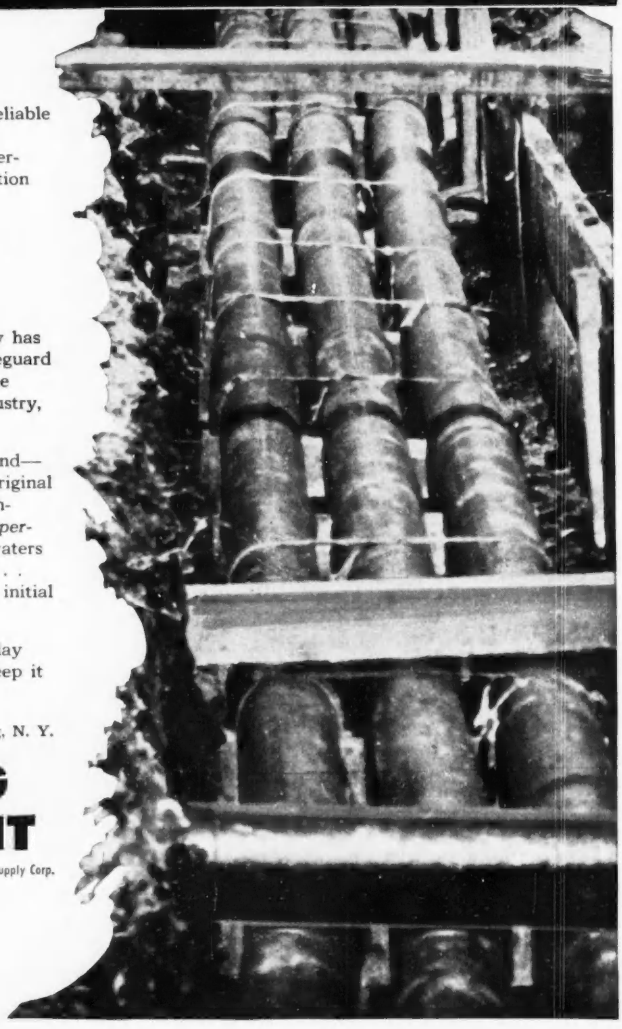
- Assures maximum protection against vibration fatigue.
- Grips conductor with absolute uniformity . . . no concentrated stresses.
- Unexcelled conductivity provides reserve capacity for short circuits and overloads . . . particularly suitable for hot-line clamps.
- Neat, inconspicuous appearance.

PLP COMPANY

PREFORMED LINE PRODUCTS COMPANY
1051 POWER AVENUE • CLEVELAND 14, OHIO

Lifetime protection for Life Lines UNDERGROUND



UTILITY COMPANIES—to maintain reliable and constant service for customers—need *permanent* protection for cables, the underground *life lines* of their modern distribution system.

1. Protection from Cable Sheath Abrasion.
2. Protection from Pulling Tensions.
3. Protection from Corrosion.
4. Protection with Cable Movement.

For over 50 years the Electrical Industry has used **ORANGEBURG CONDUIT** to safeguard cables *underground* . . . to help assure the uninterrupted flow of vital current to industry, office, farm and home.

On inspection—after 50 years underground—**ORANGEBURG CONDUIT** *reveals* its original high quality . . . reflects the unique toughness and strength of its materials, their *permanent* resistance to corrosive ground waters and chemical wastes. *Other advantages* . . . easy to handle, transport, install . . . low initial and maintenance costs.

For more complete information write today for **ORANGEBURG** Catalog No. 49. Keep it for ready reference in your files.

Orangeburg Manufacturing Co., Inc., Orangeburg, N. Y.

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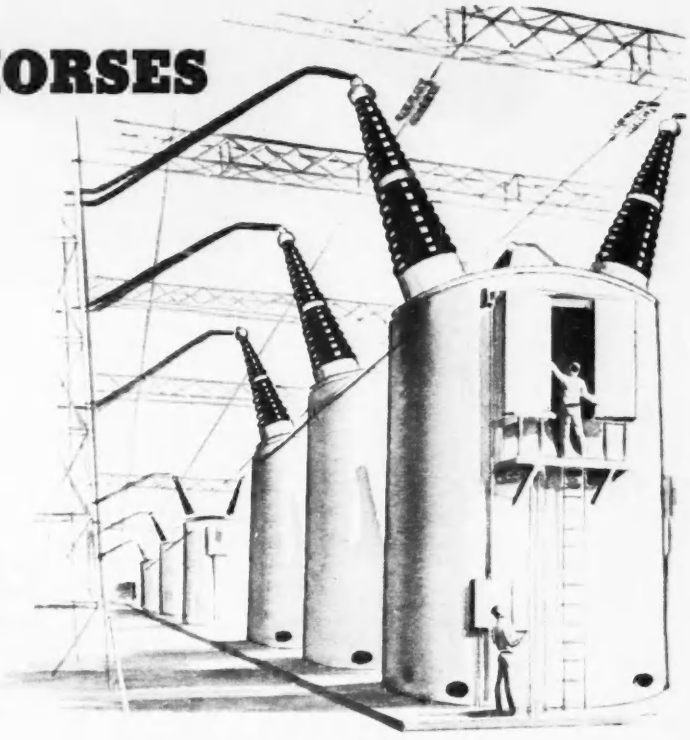
ORANGEBURG STANDARD
For installation with concrete encasement.

Where WILD HORSES Are Tamed



Hundreds of new "horsepower corrals"—where transformers cut the big, high-voltage herds down to working-sized teams—are an important part of the power utilities' nation-wide expansion program.

The engineers and field crews of Bechtel Corporation's Power Division bring to this work a deep fund of experience in all types of electrical construction—from steam and hydro-electric generating stations to substations and complete distribution systems.

BUILDERS FOR INDUSTRY
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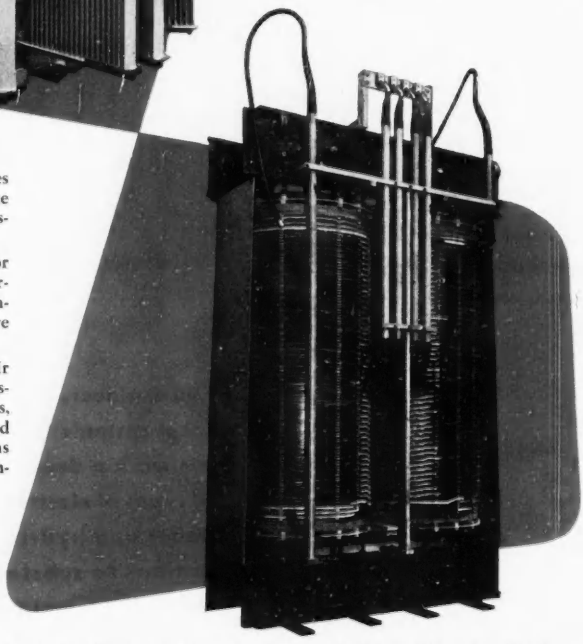
Wagner Transformers on the job . . .

16,667 kva power transformer

Single Phase, 60 Cycle
72,000 to 6,600 volts

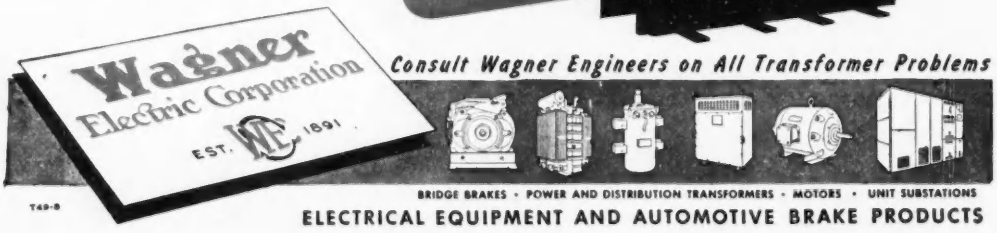


Wagner, with a background of almost six decades of transformer manufacturing, has the experience and facilities to make the building of power transformers part of the day's work.

Wagner Power Transformers are known for their *proven* dependability because they are liberally designed with extra factors of safety, constructed of carefully selected materials, and are expertly engineered, built, and tested.

Users of power transformers will find it to their interest to consult Wagner on their next transformer installation. Twenty-nine branch offices, located in principal cities and manned by trained field engineers, are ready to serve you. Bulletins TU-180 and TU-181 give information on the complete line of Wagner Transformers.

Wagner Electric Corporation
6456 PLYMOUTH AVE., ST. LOUIS 14, MO., U. S. A.



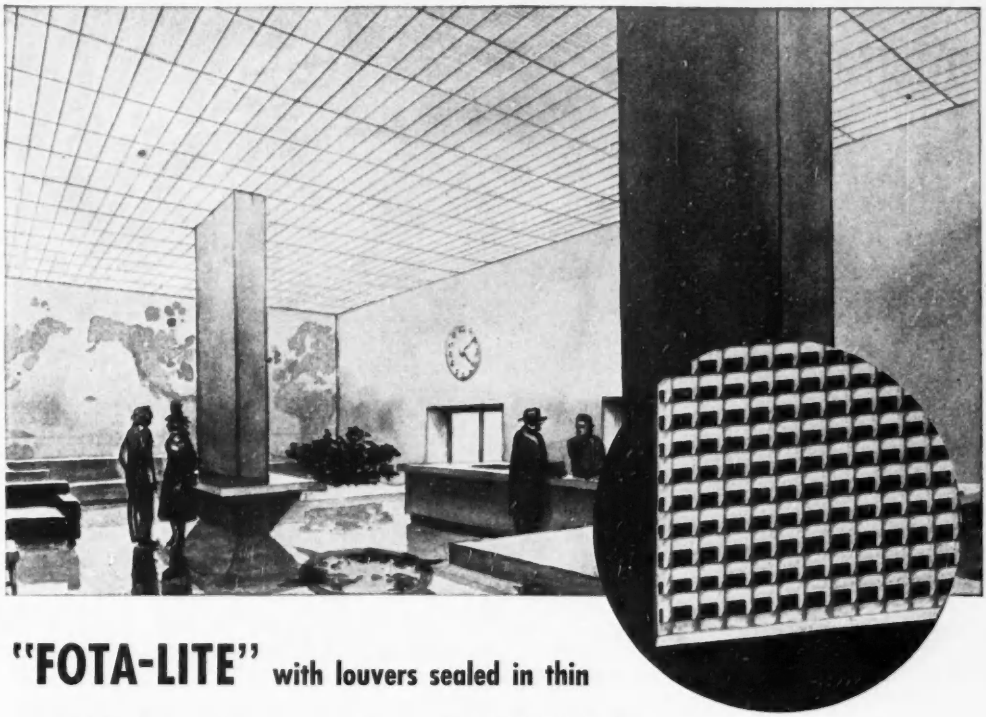
Consult Wagner Engineers on All Transformer Problems

BRIDGE BRAKES • POWER AND DISTRIBUTION TRANSFORMERS • MOTORS • UNIT SUBSTATIONS

ELECTRICAL EQUIPMENT AND AUTOMOTIVE BRAKE PRODUCTS

T49-B

SOMETHING NEW IN HIGH LEVEL ILLUMINATION!



"FOTA-LITE" with louvers sealed in thin smooth glass, gives you a clean, dust-tight installation

"FOTA-LITE," Corning's newest lighting glassware, is designed for efficient high level illumination. Instead of bulky, hard to clean materials, you control light distribution with louvers *sealed in a thin panel* of glass. Thus, fixtures can be made shallower and dust-tight. The smooth surface of "Fota-Lite" can be wiped clean quickly. Original efficiency remains unimpaired.

Due to a cell size many times smaller than conventional louvering materials, this glass, in a fixture, has the appearance of plain opal. However, light directed vertically passes almost unrestricted through the clear sections.

Strong, light in weight, free of warpage and available in standard or special patterns, "Fota-Lite" combines many advantages which radically improve louver panel lighting. It is also non-color selective, important in maintaining true color values. Ask for Bulletin LS-24.

LOUVERED GLASS FOR MODERN LIGHTING—A NEW LOUVERING MATERIAL

CORNING GLASS
PYREX

CORNING GLASS WORKS
Lighting Sales Department
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SALES OFFICES:
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CORNING GLASS WORKS, Dept. EW-4, CORNING, N.Y.
Please send Bulletin LS-24, describing Fota-Lite.
NAME _____ TITLE _____
COMPANY _____
ADDRESS _____
CITY _____ ZONE ____ STATE ____

Uptegraff potential transformers

Uptegraff Potential Transformers are made in sizes up to 69,000 volts. They are built with an extra margin of insulation strength, as a safeguard against severe over-voltage and line fluctuations.

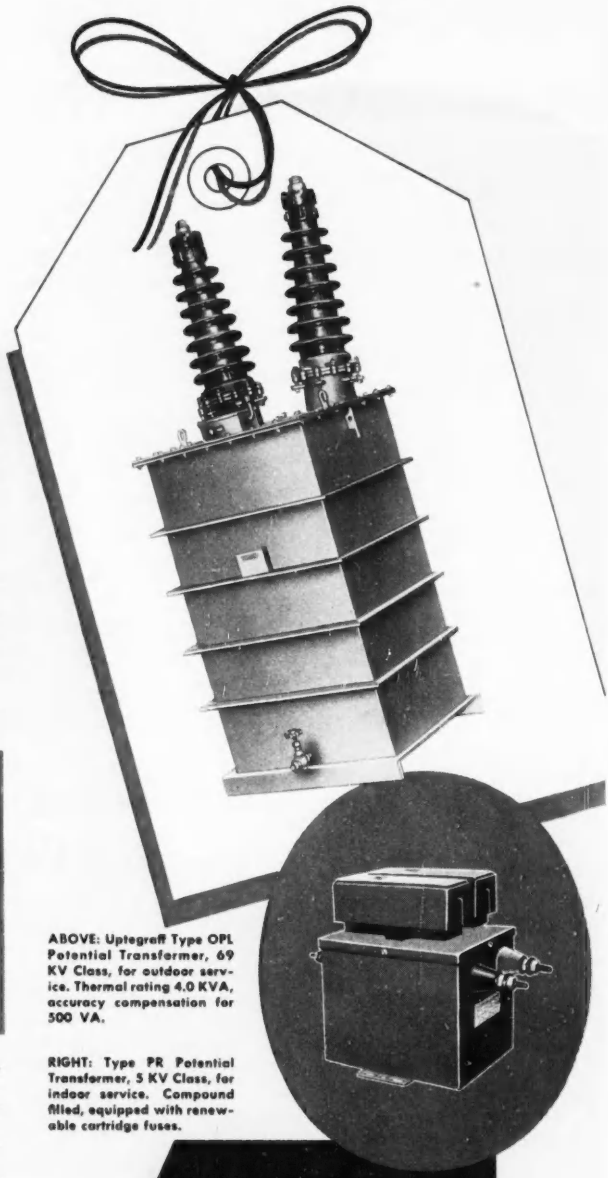
Units rated for more than 7200 volts:

- ★ **Supplied either oil or askarel-filled as desired**
- ★ **Vacuum-impregnated coils; vacuum-filled tank**
- ★ **Units in 69 KV Class provided with tank suitable for vacuum filling in the field**

The tank shown above is typical of Uptegraff design, with extra ribbing to add strength and permit vacuum filling in the field if, for any reason, the oil is drained and refilling becomes necessary.

Sizes and types are available for all classes of indoor and outdoor service.

Write for details and complete data.



ABOVE: Uptegraff Type OPL Potential Transformer, 69 KV Class, for outdoor service. Thermal rating 4.0 KVA, accuracy compensation for 500 VA.

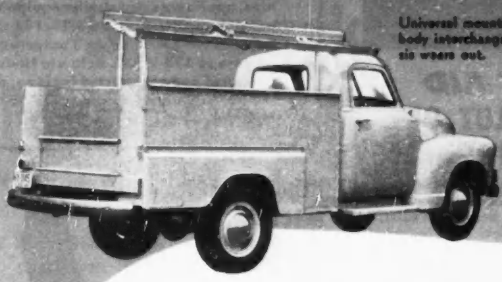
RIGHT: Type PR Potential Transformer, 5 KV Class, for indoor service. Compound filled, equipped with renewable cartridge fuses.

UPTEGRAFF
Transformers
Power · Distribution
Specialty · Instrument

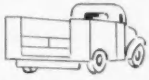
R. E. UPTEGRAFF MANUFACTURING COMPANY · *Scottdale, Pennsylvania*

American 4460
GENERAL SERVICE BODY

Streamlined for good appearance—efficiently designed for good service.



Universal mounting makes 4460 body interchangeable when chassis wears out.



4460—General Service Body

TS-76—Telephone Body

Hydraulic Tower Lift

B-4 Crew in Body

DPL Line Construction Body

The American Line
STANDARD CHOICE FOR '49

Service Men are always equipped for service with this ROLLING STOREHOUSE

● Ask your service crew how many different items they must carry on calls. Then look over the design of this popular American 4460 Truck Body.

The large, heavy or bulky items (appliances, meters, etc.) ride in the open bed. The dozens of small units . . . tools, valves, wire, screws, fittings, pipe, spare parts, etc., can be carried in the horizontal and vertical locked compartments on each side of the body.

This 4460 Truck Body eliminates those pesky and expensive "call backs" for "forgotten items." Service men are always equipped with tools and parts for any job.

Widely used by utilities and other businesses in all states, for general service, meter work, appliance sales and service and general repair work.

Available in 75", 90" or 104" body length. Write for new informative circular . . . just off the press.

THE *American* COACH & BODY COMPANY

MAIN OFFICE AND PLANT — 9503 WOODLAND AVE., CLEVELAND 4, OHIO
CALIFORNIA DIVISION — 432 FIFTH STREET, OAKLAND 7, CALIFORNIA

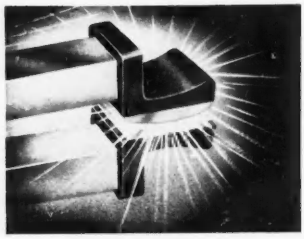
SALES OFFICES: INSURANCE EXCHANGE BLDG., DES MOINES 9, IA. · 207 LAKE STREET, MONROE, N. Y. · HEALEY BLDG., ATLANTA, GA.

DISTRIBUTORS: BAKER EQUIPMENT ENGINEERING CO., SUMMIT & NORFOLK STS., RICHMOND 11, VA. · EQUIPMENT SERVICE, INC., 1 WAWARME AVE., HARTFORD 6, CONN.

STACKPOLE

CARBON • GRAPHITE • MOLDED METAL

Engineering News



FIRST AID FOR A LOT OF CONTACT TROUBLES

Having trouble getting contacts for long life and low contact resistance on continued operations where heavy arcs exist, or under closed conditions? Then Stackpole Silver-Tungsten Contacts are probably the answer to your problem—whether it applies to a circuit breaker, motor controller, transformer protective device, aviation relay, contactor or similar equipment that requires an extremely durable contact.

TYPICAL STACKPOLE SILVER TUNGSTEN GRADES

Grade	Composition % Silver	Cross Breaking Strength Lbs. per Sq. in.	Hardness Rockwell Superficial	Density	Electrical Conductivity Ag = 100	Contact Resistance Estimated Ag = 100
FW56	70	57,000	15T75	12.0	75	120
FW49	50	82,000	30T56	13.2	55	150
FW41	35	108,000	30T72	14.6	45	200
FW34	32	110,000	30T70	14.7	40	250

Only a few standard types are available. Best results are obtained by laboratory testing of contact mixes containing different percentages of silver and graphite. These tests are made on the actual device under operating conditions—a service Stackpole gladly renders to makers of original electrical equipment. Write for details.

NEW! INEXPENSIVE 3 AMPERE SNAP SWITCHES

These sturdy little switches meet the need for units having sufficient current-carrying capacity for electrical toys, appliances and similar equipment. SS-26 is single-pole, single-throw and SS-26-1 is single-pole, double-throw. Both are rated at 3 amperes at 125 V. AC or 1 ampere at 125 V. DC. Both are Underwriters approved. Designed and constructed for long, dependable service, they are available at low cost. Samples on request to quantity users.

PUMP SHAFT MECHANICAL SEALS

Pump or compressor seals molded from suitable mixtures of carbon, graphite or carbon-graphite offer distinct advantages, for many applications. In contrast to the ordinary "packing type" seal, these molded Stackpole *mechanical* units seal the shaft tightly and *without any wearing surface bearing on it.* This prolongs shaft life while assuring greater operating efficiency. In addition, Stackpole molded seals are unexcelled for difficult applications where a tight seal must be maintained under high pressure conditions.

Mechanical seals can be molded to close tolerances and to a variety of shapes. As amply proved by Stackpole's broad experience, they are ideal for many different shaft sealing applications. Write, giving details of your application for specific recommendation.

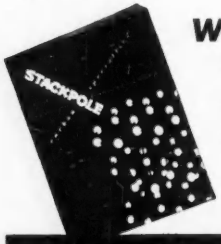
WELDING OR BRAZING CARBON ELECTRODES *that last 3 to 4 times as long*

UNTREATED after 500 brazing operations

STACKPOLE "F" TREATED after 1300 similar operations

Here's where you can make a substantial saving, reduce machine "outage" time while tips are being dressed or changed, increase welding and brazing efficiency.

Stackpole's famous "F" treatment (which minimizes oxidation) produces tips that operate at temperatures above red heat, require dressing less than one-third as often, and last from 3 to 4 times longer than ordinary, untreated tips. On a typical high-temperature job where conventional carbons were changed hourly, Stackpole "F" treated carbons lasted all day and required dressing only about one-third as often. Write for samples, stating size and shape. Mention company connection.



Write for this CARBON SPECIALTY ENGINEERING DATA BOOK

More than a catalog, Stackpole Booklet 40 contains a wealth of data to help you evaluate the electrical, mechanical or chemical advantages of carbon, graphite or carbon-graphite on a long list of applications. Write for copy today on your company stationery.

STACKPOLE CARBON COMPANY • ST. MARYS, PA.

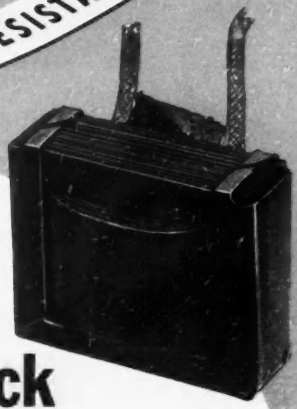
"EVERYTHING IN CARBON BUT DIAMONDS"

DIP TANK STABILITY

HIGH TEMPERATURE LIFE

MOISTURE RESISTANCE

FLEXIBILITY



IRVINGTON'S #100 clear #500 black INSULATING VARNISH

(Internal Drying)

Here are high dielectric strength varnishes that are "tops" in insulation protection for high heat applications requiring high temperature flexible life. These varnishes remain tough, flexible and stable under the most rugged operating conditions. They penetrate deeply, dry from the inside, bind coil windings into a unit acting mass, preventing movement of wires. They resist damaging heat, moisture, oil, acids, alkalies . . . and will not attack enamel coating on magnet wire.

Use #100 where a clear varnish film is required for instrument coils, field coils, transformers and similar wound structures . . . leads remain flexible and are easily identified where color coded.

Use #500 where an exterior black coating, plus all of the excellent properties of Irvington #100 are needed . . . fine for infra-red baking. This varnish is suited to motor coils, wound stators and field coils.

Both #100 and #500 can lower manufacturing cost, and improve product quality. Try them. Samples, with complete technical data, sent upon request.

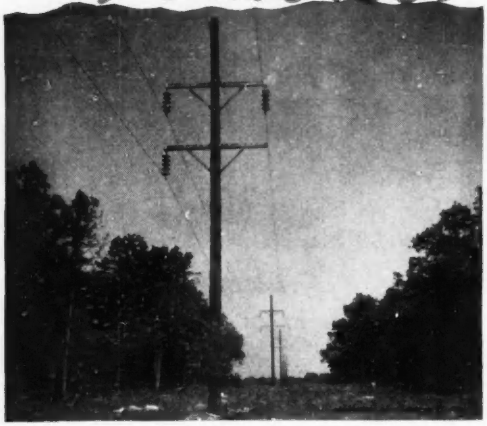
"Look to Irvington **for Continued Leadership in Insulation"**

IRVINGTON *Varnish & Insulator Company*

Irvington 11, New Jersey

Authorized distributors in Atlanta; Baltimore; Berkeley; Bluefield, W. Va.; Boston; Charlotte; Chicago; Cleveland; Dallas; Denver; Detroit; Los Angeles; Milwaukee; Minneapolis; New Hartford, N.Y.; New Orleans; Philadelphia; Pittsburgh; Portland, Ore.; St. Louis; Seattle; Hamilton, Ont., Canada.

Amcreco CREOSOTED POLES



do 3 big jobs

1 **INCREASES LIFE EXPECTANCY OF YOUR LINES** Carefully selected, naturally strong timber is scientifically pressure treated the entire length to produce poles of highest strength and durability. Service records showing from 25 to 40 years of useful pole life prove the long life expectancy of Amcreco creosoted poles.

2 **LOWERS INITIAL COST . . . REDUCES MAINTENANCE EXPENSE** — Poles of practically constant strength promote pole line economy. Smaller sizes and longer spans are possible . . . a lower factor of safety can be allowed . . . lines stay up longer . . . fewer replacements of poles and cross arms are required.

3 **GIVES DEPENDABLE SERVICE UNDER SEVEREST CONDITIONS**—Lines constructed with Amcreco poles are planned for the future. Built for permanence and dependable service under all conditions, Amcreco creosoted poles provide greater long-term economy.

Get the whole story about long lasting, money saving Amcreco poles. Ask for detailed information on actual service records. Write today.

Amcreco
Lowry Process
Creosoted Products

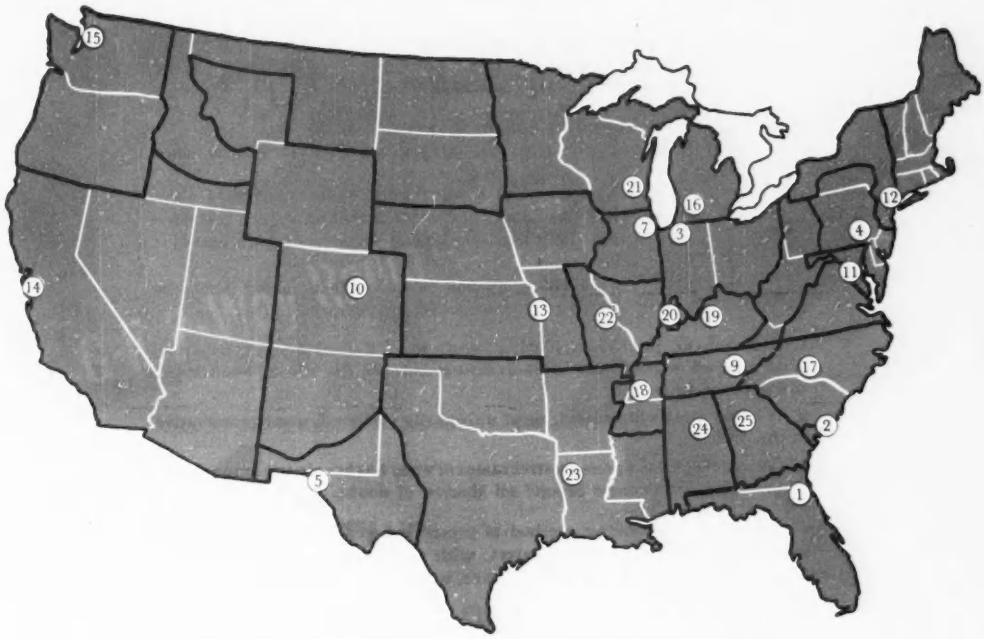
POLES
CONDUIT
CROSS ARMS

AMERICAN CREOSOTING COMPANY
INCORPORATED
COLONIAL CREOSOTING COMPANY INCORPORATED
GEORGIA CREOSOTING COMPANY INCORPORATED
LOUISVILLE, KENTUCKY

Pressure treated for strength that lasts

From COAST to COAST

ELECTRICAL TRANSMISSION and DISTRIBUTION EQUIPMENT



REPRESENTATIVES IN THE FOLLOWING CITIES:

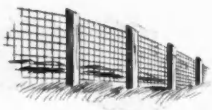
1. H. Jack Belcher
   Jacksonville, Florida
2. Butt's Electrical Supply
   Charleston, South Carolina
3. Arnold C. Blaese
   Valparaiso, Indiana
4. John P. Clark Company
   Philadelphia, Pennsylvania
5. Electrical and Mechanical Supply Co., Inc.
   El Paso, Texas
7. Engineered Sales, Inc.
   Chicago, Illinois
9. Claude E. Fox
   Knoxville, Tennessee
10. Franklin Sales Company
    Denver, Colorado
11. Ernest Hover
    Silver Spring, Maryland
12. Kahant Associates
    New York, New York
13. O. C. Lake Sales Company
    Kansas City, Missouri
14. Pacific Electro Sales, Inc.
    San Francisco, California
15. Joseph C. Platt
    Seattle, Washington
16. F. W. Pollock Company
    Jackson, Michigan
17. Purser and London, Inc.
    Charlotte, North Carolina
18. Southland Sales Agents
    Memphis, Tennessee
19. J. F. Shouse and Company
    Louisville, Kentucky
20. Shouse Machinery Company
    Evansville, Indiana
21. A. T. Timerman
    Milwaukee, Wisconsin
22. Edwin S. Waterman
    St. Louis, Missouri
23. Williamson Sales Company
    Shreveport, Louisiana
24. C. L. Smith
    Birmingham, Alabama
25. J. C. Howell (Factory Territory)
    Atlanta, Georgia

Southern States Equipment Corp.
HAMPTON GEORGIA

Some things to consider about Wood Preservation

Every year American railroads put in service some 45 million cross ties.

Every year American telephone and telegraph companies set out some 8 million poles.



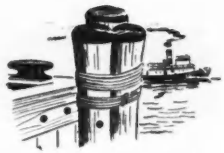
The choice of a wood preservative to protect these multi-million dollar investments is a serious matter—especially in these days of exceedingly high costs for lumber and labor.

That's why the following facts about Creosote Oil deserve your careful consideration:

1. Creosote Oil, properly applied, protects wood against dry rot, termites, fungi and all wood-destroying organisms—extends the life of wood three to five times, or longer.

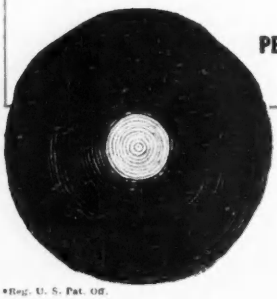
2. It is the most widely used, most universally preferred, wood preservative in the world.

3. Creosote Oil for the pressure-treatment of wood has been in use long enough to *prove* its effectiveness beyond all shadow of doubt.



When—and if—a truly better method of preserving wood is found, you may be sure that Barrett, with more than a half-century of wood-preserving experience, will be among the first to sponsor it.

Until then, the sound way to protect your lumber investment is the way that has worked for the last hundred years—by pressure-treatment with first-quality, time-tested Creosote Oil.



PENETRATES . . . PRESERVES . . . PROTECTS

THE BARRETT DIVISION

ALLIED CHEMICAL & DYE CORPORATION

40 Rector Street, New York 6, N. Y.

Barrett®

*Reg. U. S. Pat. Off.

Tops IN THE MILE-HIGH LEAGUE!

● The Public Service Company of Colorado handles electricity and gas distribution and transmission for its customers in the mountainous north-central portion of the state. For maintenance work, for readings, for "cutting in" new equipment in inaccessible areas where other means of communication are not available, the company finds G-E radio an indispensable, money-saving tool.

This utility's trouble trucks, line trucks, patrol vehicles and compressors, as well as supervisors' cars are in touch with one another and with headquarters at Denver by radio.

J. M. Wissenbach, Engineering Department, shown above, reports that dispatching by G-E radio *materially cuts elapsed time between receipt of complaint and adjustment of trouble.*

General Electric specializes in radio communication systems for utilities faced with difficult problems of terrain or weather. For complete information call the G-E office nearest you or write: *General Electric Company, Box 1122, Electronics Park, Syracuse, New York.*

Before You Select Any Radio Communication Equipment—

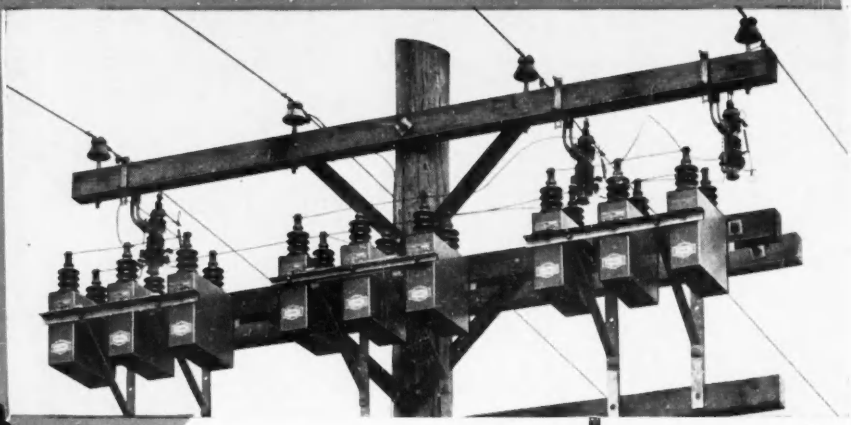
Get This Bulletin FREE!

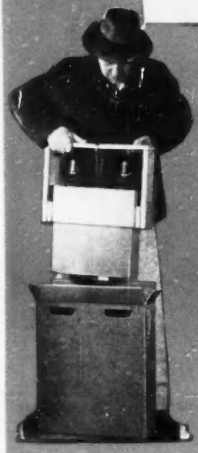
Colorful booklet about General Electric radio communication will be sent to you on request. Ask for it.

You, too, can put your confidence in—

GENERAL ELECTRIC

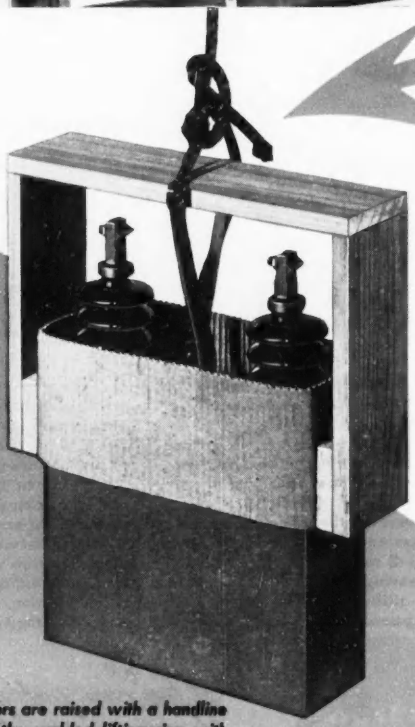
New KEARNEY





In or out of the carton, capacitor bushings are protected against damage. The entire weight of the capacitor is carried by the wood framing.

Hand-holds in the carton are a practical convenience for storekeepers or linemen in handling capacitors.



Capacitors are raised with a handline through the welded lifting ring with the wood framing intact to protect the capacitor against accidental damage.

Shunt Capacitors

For Power Factor Correction

Built by Engineers with Over 15 Years of Capacitor Experience,

Give You These Advantages:

1. **Fit all standard mounting racks**
2. **Extra heavy wet process porcelain bushing**
3. **Welded sheet steel case with hot zinc spray and enamel coating provides double protection to reduce maintenance cost, and—**

4 Exclusive Kearney protective packaging feature

This important feature assures complete protection from the moment of packing until the capacitor is installed in factory-perfect condition on the pole.

Loss of capacitor vacuum through misuse or damage to the bushings by improper handling, is the greatest single factor in causing faulty operation. That's why the Kearney protective wood bar is attached firmly to the capacitor and is of sufficient width and strength to protect the capacitor from the hazards of shipping and installing. The corrugated shipping container, with convenient hand holds, permits easy handling of the capacitor with absolutely no strain on the bushings.

In the field the capacitor is lifted from the container by the wood bar handle, then a hand line is attached to the built-in metal lifting ring and the capacitor is lifted into the hanger with the *wood bar protective handle intact*. The removal of the single band from the lifting ring permits easy removal of the wood bar, and the capacitor is safely installed.

Write for bulletin 21-1 for complete information about this improved Shunt Capacitor.

BETTER CONSTRUCTION—SAFER MAINTENANCE

Always Specify KEARNEY PRODUCTS *for the Job*

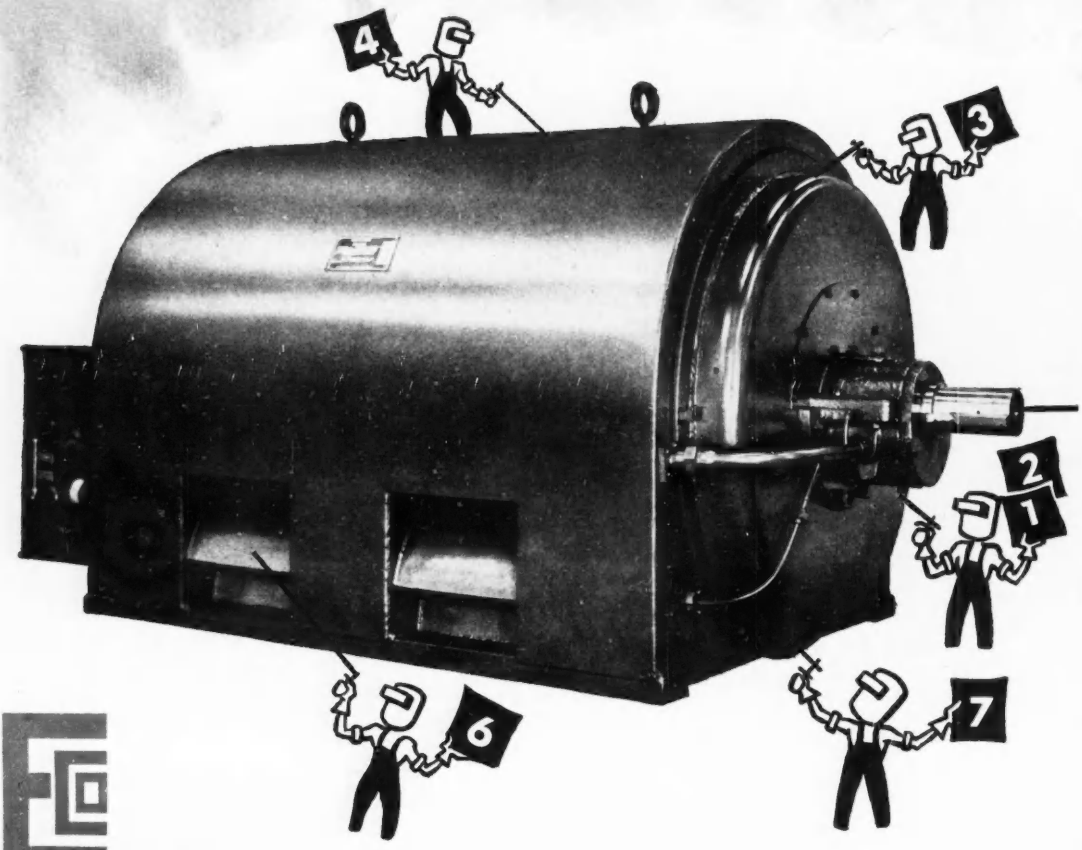
JAMES R. KEARNEY CORPORATION ST. LOUIS, MO.

4224-42 CLAYTON AVE. – ST. LOUIS 10, MISSOURI

Canadian Plant, Guelph, Ontario

130

Never before in



Elliott

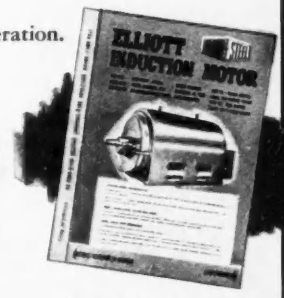
FABRI-

large 2-pole motors

A standardized line of welded all-steel construction; ratings 250 to 3500 hp, 2-pole; drip-proof, splash-proof, enclosed separately (forced) ventilated, enclosed self (pipe or base) ventilated, enclosed self-ventilated with built-in coolers, sleeve bearings (ring-oiled or pressure lubricated) with all these features:

1. Removable, long life, split-sleeve bearings and housings for easy inspection or replacement.
2. Extra sealing of bearing housings against oil leakage.
3. Rigid, one-piece, steel bearing brackets* — yet easy to handle for maintenance.
4. Rigid, heavy, all steel frame to suppress double frequency noises.
5. Dynamically balanced rotor for smooth, long life, operation.
6. Directed ventilation for extra cooling.
7. Rotor and air passageways designed for quiet operation.

*Available with pedestal bearings on request.



L-790

ELLIOTT COMPANY
RIDGWAY DIVISION, RIDGWAY, PA.
Plants at: JEANNETTE, PA. • RIDGWAY, PA. • SPRINGFIELD, O. • NEWARK, N. J.
DISTRICT OFFICES IN PRINCIPAL CITIES

For descriptive Bulletin PB 7000—1, write to Department ER, Elliott Company, Ridgway Div., Ridgway, Pa.

-STEEL Motors

Keep the Home Freezers Freezing!

. . . and the oil burners burning, the radios playing and the power consumers happy . . . by specifying Duraline.

For Duraline combines URC saturants and finishers with a greatly improved type of covering. This weatherproof covering has an interlocked, *felted* construction that prevents moisture penetration and vastly reduces outages caused by branches and other foreign objects contacting lines during wet weather.

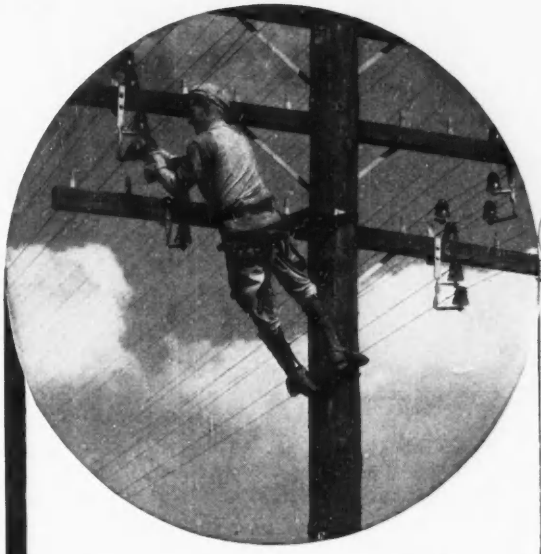
During emergency conditions of wind, sleet, long periods of wet weather—when danger to lines is the greatest—Duraline gives its best protection . . . at no extra cost. Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York.

4018

ANACONDA
from mine to consumer

Duraline* URC WEATHERPROOF

STAYS PUT!



Crossarms, as well as poles, need Penta treatment.

Linemen prefer Penta-clean treatment.

PENTA CHLOROPHENOL preservative

(Monsanto's Santophen 20)

clean, long-lasting protection

Poles and crossarms properly treated with Penta are CLEAN after treatment and STAY CLEAN through years of added life. Linemen prefer to work with Penta-treated poles, since Penta does not bleed—will not rub off and stain hands or clothing.

Penta's high toxicity to wood-rotting fungi, termites and other wood-boring insects means long-lasting protection. Its toxic characteristics are identical year after year because the chemical composition of Penta can always be laboratory-controlled.

The Penta treatment, either by pressure or open-tank method, is simple. . . To learn more about its advantages, send for a copy of a new Monsanto booklet, "PENTA . . . the best protection for poles and crossarms." Address MONSANTO CHEMICAL COMPANY, Desk C, Organic Chemicals Division, 1758 South Second Street, St. Louis 4, Missouri.

Santophen: Reg. U. S. Pat. Off.

PENTA a Non-Conductor—The Penta treatment, which does not increase the conductivity of wood, is also an excellent preservative for platforms, fencing, flooring, roofing and other wood construction.

MONSANTO
CHEMICALS for PLASTICS

MONSANTO CHEMICAL COMPANY
Desk C, Organic Chemicals Division
1758 South Second Street, St. Louis 4, Missouri

Please send me a copy of your new booklet, "PENTA . . . the best protection for poles and crossarms."

Name _____ Title _____

Company _____

Address _____

City _____ State _____

SERVING INDUSTRY . . . WHICH SERVES MANKIND

NOW! A NEW SOURCE OF ACSR

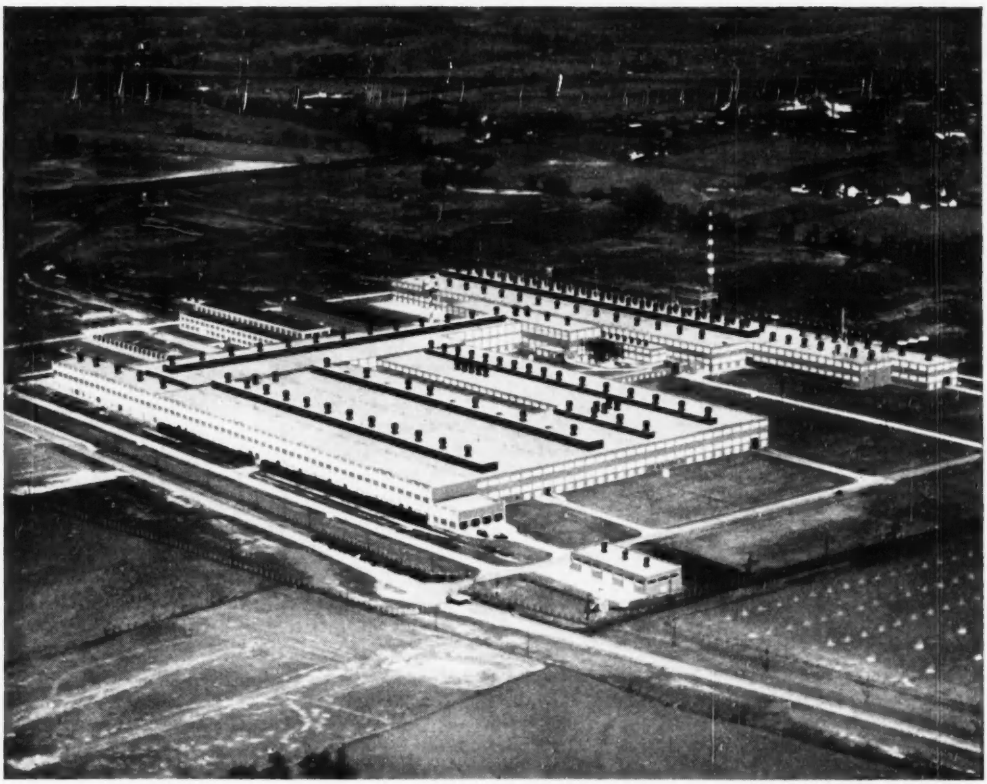
Permanente Metals to produce quality Aluminum Cable Steel Reinforced (ACSR) and Aluminum Cable, in full range of standard sizes.

Permanente Metals has equipped its Newark, Ohio, plant with new wire and cable production facilities to make it one of the most modern in the world. It was built in 1943 for wartime production of rod and bar.

Manned by experienced, highly skilled personnel, it will produce aluminum cable of high quality and uniformity—Kaiser ACSR and Kaiser Aluminum Cable.

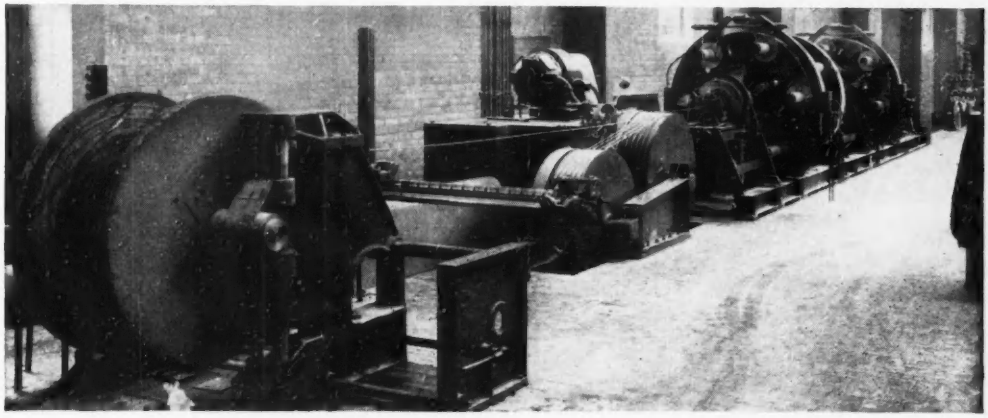
Thousands of U.S. manufacturers in other fields look to Kaiser Aluminum for finest quality—and to Permanente Metals for a brand of service that has set high standards for dependability.

You're invited to do the same! For more information about Kaiser Aluminum Cable, an inquiry to our nearest office will bring an immediate response.



NEWEST ADDITION to Permanente Metals' expanding facilities is one of the world's most modern aluminum rod, bar, wire and cable mills located at Newark, Ohio—where Kaiser Aluminum Cable is produced.

AND ALUMINUM CABLE!



NEW EQUIPMENT now being installed will give Permanente Metals' Newark, Ohio, plant wire and cable production facilities that are unsurpassed by any in the nation.

Permanente Metals

PRODUCERS OF

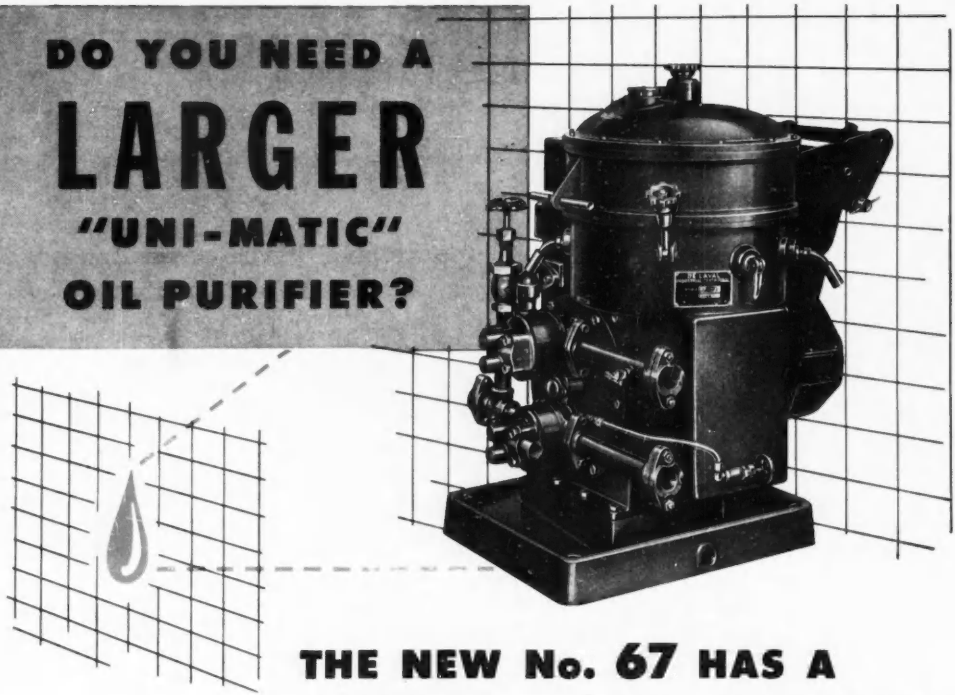
Kaiser Aluminum Cable

CONTACT
PERMANENTE PRODUCTS CO.
SALES OFFICES IN:

ATLANTA
CHICAGO
CINCINNATI
CLEVELAND
DALLAS
DETROIT
HOUSTON
INDIANAPOLIS
KANSAS CITY
LOS ANGELES
MILWAUKEE
MINNEAPOLIS
NEW YORK
OAKLAND
PHILADELPHIA
PORTLAND, ORE.
SALT LAKE CITY
SEATTLE
SPOKANE
ST. LOUIS
WICHITA

PERMANENTE METALS' completely integrated production facilities assure you of a dependable supply of Kaiser Aluminum Cable. Twenty-one conveniently located sales offices provide prompt service.

DO YOU NEED A LARGER "UNI-MATIC" OIL PURIFIER?



THE NEW No. 67 HAS A CAPACITY OF 450-550 G.P.H.

Now it is possible to obtain a larger De Laval "Uni-Matic" Oil Purifier than has ever been available before. The new No. 67 has a capacity of approximately 450 gph. (Navy rating) when purifying turbine oil. On other oils, the capacity of the No. 67 will vary from 200 to 550 gph. depending on the viscosity and temperature of the oil being purified.

A De Laval "Uni-Matic," whatever its size, is a complete oil purification unit consisting of a De Laval centrifugal machine with integral pumps, and, where desired, with heater. ***All*** De Laval machines make most effective use of centrifugal force to remove both of the chief contaminants of oil—***water*** and ***dirt***—and do it so completely that bearings receive the ultimate in protection, and fuel oil yields maximum B.T.U. value.

- ***Write for Bulletin MU-1.***

De Laval

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

LUBRICATING OIL PURIFIERS

JOSLYN STREET LIGHTING

Luminaires, brackets and steel standards all engineered for

HIGH OPERATING EFFICIENCY, DURABILITY and ATTRACTIVE APPEARANCE

now available on

QUICK DELIVERY

The 25′ pole with 6′ bracket and base having 3″ x 5″ hand hole, as illustrated, is now carried in stock in our Chicago plant . . . Many other designs are available for various mounting heights, bracket lengths, and with provision for mounting transformer in base or with fittings for overhead wiring . . . The wall thickness of our poles at the base is over ¼″, giving that added assurance of strength and long life . . . Complete information on request.

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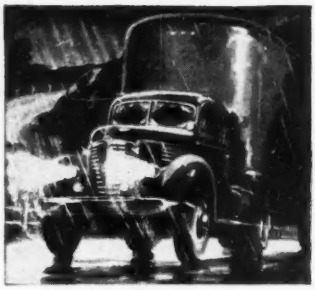
Complete Pole Line Equipment

20 NORTH WACKER DRIVE, CHICAGO 6, ILL.

G. AND
PPLY CO.

First in heavy-duty truck sales for 17 straight years!

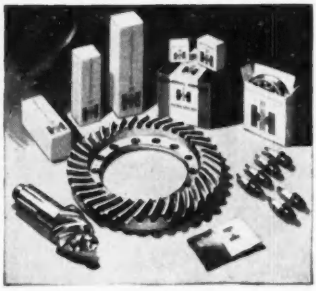


1. Rated first in value by America's most exacting truck buyers!

For 17 straight years, registration figures for new trucks with gross weight ratings over 16,000 lbs. have shown International Trucks in first place. Would America's most exacting truck buyers have given Internationals that vote of confidence unless they knew Internationals were the best value in the heavy-duty truck field?

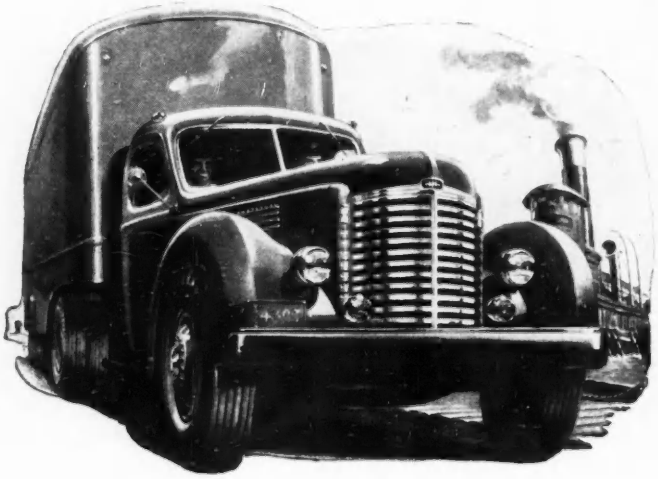
2. Backed up by the nation's largest exclusive truck service organization!

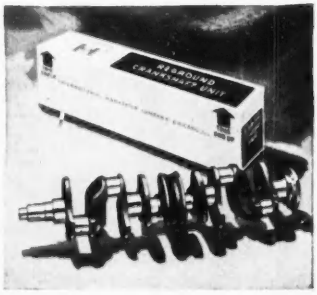
4,700 International Truck Dealers and 170 Company-owned Branches and Service Stations stand ready to keep International heavy-duty trucks operating at peak efficiency. Factory-trained mechanics and special tools are on hand to give International Trucks the diagnosis, service, testing and repairs to correct any trouble.



3. Precision-engineered parts help keep the leader leading!

Replacement parts have a place on the all 'round truck team that keeps Internationals ahead of the field. They're precision-engineered parts, just like the originals. They're made to fit and do a better job and last longer. Ample inventories of parts and approved accessories are available at all Dealers and Branches.





4. Inexpensive factory-rebuilt exchange units are important, too!

Owners of heavy-duty International Trucks also save money on crankshafts, clutches, carburetors, transmissions, differentials, brake shoes and electrical equipment. Complete International units, reconditioned and factory-rebuilt, are priced way below new ones and covered by new unit International warranty.

5. You don't stay first in sales for 17 straight years unless you're first in value!

No matter what model International Truck you buy—heavy, light or medium-duty—you get the same basic values that have made International Trucks first in the heavy-duty truck field for 17 straight years.

You get a rugged truck that hasn't been weakened by a single compromise with passenger car engineering.

You get a truck specialized to meet your particular requirements by truck engineers. You have 22 basic International Truck models and 1,000 truck combinations to choose from.

For real truck value, see your nearest International Truck Dealer or Branch before you buy any truck.

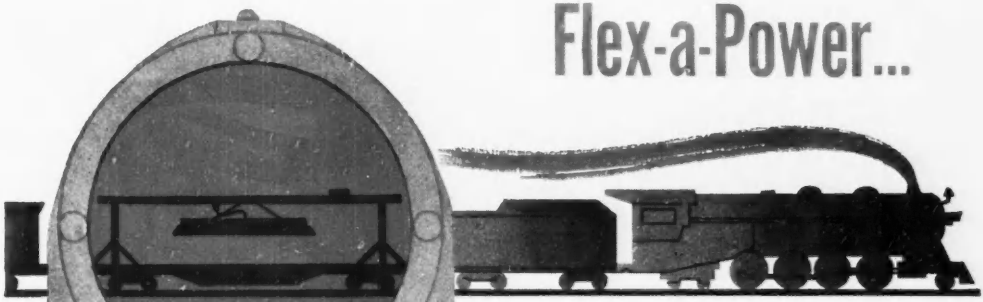
International Harvester Builds
McCormick Farm Equipment . . . Farmall Tractors
Motor Trucks . . . Industrial Power
Refrigerators and Freezers

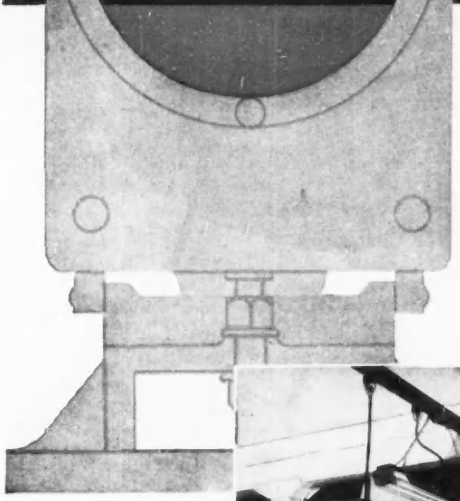
Tune in James Melton and "Harvest of Stars" NBC, Sunday afternoons

INTERNATIONAL TRUCKS

INTERNATIONAL HARVESTER COMPANY · CHICAGO

You get 6 big advantages with New LTG Flex-a-Power...

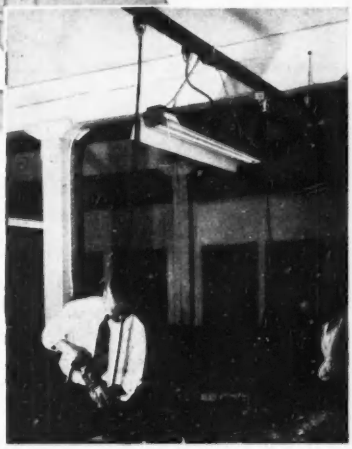




The only unusually rugged plug-in or trolley busway in 2, 3 or 4 pole construction in one compact housing.

Pre-fabricated LTG FLEX-A-POWER — rated 50 amps — 250 v, AC or DC — supplies power for fluorescent lights and power tools. It provides both trolley power take-off and a continuous outlet — you can tap at any point . . . ideal for industrial plants, offices, stores, arenas, work shops and garages. Here are more new features:

1. **EASY TO INSTALL** — simplified hanging and joining methods speed up installation.
2. **IT'S ECONOMICAL** — two or more circuits can be run in one housing — controlled separately.
3. **PERMITS BALANCED LOADS** — plugs or trolleys are polarized which provides a convenient means of balancing loads.
4. **IT'S REALLY RUGGED** — rigid construction of housing itself prevents sagging — only 2 hangers needed for each 10 ft. section.
5. **MORE FLEXIBILITY** — standard fittings such as elbows and radius sections permit economical custom installations — easy to disassemble and relocate.
6. **GREATER CONVENIENCE** — trolley with silver alloy contacts may be inserted or removed at any point along the run — no "drop-out" section required.



FOR MORE INFORMATION, write for circular TEC-3, THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Conn.

Men Who Observe the Best Electrical Practice Make It a Practice to Use

TRUMBULL (T) ELECTRIC

TRUMBULL'S TRAINLOAD OF NEW PRODUCTS

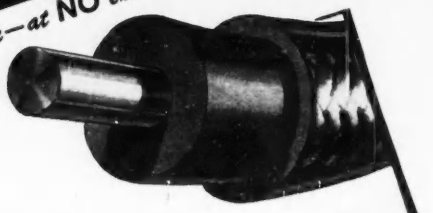
At last

BUILDING WIRE THAT LASTS LONGER, PULLS EASIER, SAVES MONEY

...Thanks to TRIANGLE'S new braid of GLAZON

TRADE MARK

For EXTRA value—at NO extra cost—Insist on "GLAZON"



What "GLAZON" is:

"Glazon" is a tougher, more flexible, longer-lasting braid that combines the desirable properties of an inorganic substance derived from glass with those of special saturants to achieve a new high in safety and durability under the most adverse conditions. This new protective covering gives:

LONGER LIFE. Conductors and insulation are doubly protected by a stronger, tougher, more impervious and more durable covering than heretofore possible.

SMALLER DIAMETER. Braid, although stronger, is considerably thinner. Strands lie flatter, clasp insulation tighter, absorb less saturant—reducing diameter.

GREATER FLEXIBILITY. Less bulk and greater elasticity of the braid increase flexibility.

SMOOTHER SURFACE. Uniformity of fiber and tighter lays eliminate the uneven surface common to many braided coverings.

GREATER RESISTANCE to the destructive elements of man and nature: water, heat, oil, acid, corrosive fumes, fungus, rodents, sunlight, freezing, rotting.

IMPROVED FISHABILITY. "Glazon" covered wire can be snaked through longer conduits, around sharper bends, *easier, quicker,* than any other type.

EVEN SURFACE, free from bumps and ridges, slides easier.

SMALLER DIAMETER saves space, makes it twice as easy to snake in "that last one."

SMOOTH FINISH prevents sticking, reduces friction on long runs and around sharp bends.

TOUGH COVERING resists impact and abrasion.

GREATER FLEXIBILITY saves time in wiring every junction box, switch box, outlet box.

Costs No More—Yet Saves At Every Step of the Wiring Job

Available in sizes from No. 14 through No. 6 AWG with solid or stranded conductor.

Types R, RH, RW.

If It's "GLAZON" It's Made by TRIANGLE . . .
If It's Made by TRIANGLE It MUST Be Right!

For full details, contact your nearest Triangle jobber, or write

ARTERIES FOR ELECTRICAL SYSTEMS — INCORPORATED — IT MUST BE RIGHT!

TRIANGLE CONDUIT & CABLE CO., INC.

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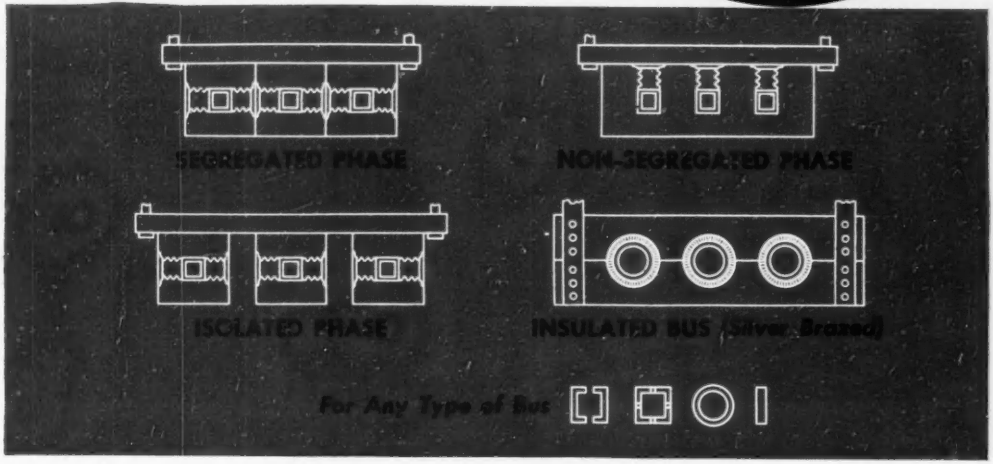
BUILDING WIRE • BARE WIRE • ARMORED CABLE • "GLAZON" TRIEX NON-METALLIC SHEATHED CABLE • SERVICE ENTRANCE, SERVICE DROP, VARNISHED CAMBRIC BRAIDED OR LEADED TRIOPRENE TRENCH, POWER AND PARKWAY CABLES RIGID CONDUIT • ELECTRIC METALLIC THIN WALL CONDUIT • FLEXIBLE STEEL CONDUIT

A TYPE OF ELPECO "UNITIZED" BUS RUN

To Fit Every Need



Advantages of *"UNITIZED"* Bus Run

DESIGNED AS A UNIT TO FIT YOUR JOB

Each Elpeco Unitized Bus Run is factory designed as an electrical and mechanical unit to fit the requirements of the individual job. Phase to phase clearance, phase to ground clearance, insulation impulse level, and mechanical stresses caused by short circuit are equal to or greater than the associated apparatus.

FACTORY ASSEMBLED AS A UNIT

Assembly at the factory by skilled men with engineering supervision avoids field assembly mistakes and cut and try methods.

FACTORY TESTED AS A UNIT

Mechanical test assures correct dimensions to meet specifications, also adequate mechanical strength of the unit. Electrical test made for impulse level and short circuit strength of the unit.

SHIPPED AS A UNIT COMPLETELY ASSEMBLED

Elpeco unitized bus run is shipped completely assembled. Where unusual dimensions are encountered, the bus run is divided into convenient size for shipment.

BIG SAVINGS IN INSTALLATION TIME

Simple installation of completely assembled unit eliminates field assembly of parts, gives big savings of installation time and cost.

WEATHERTIGHT

Suitable gasketing of the bus run excludes rain, dust and dirt. Installation can be outdoors without the construction of any special enclosure permitting further savings in building cost.

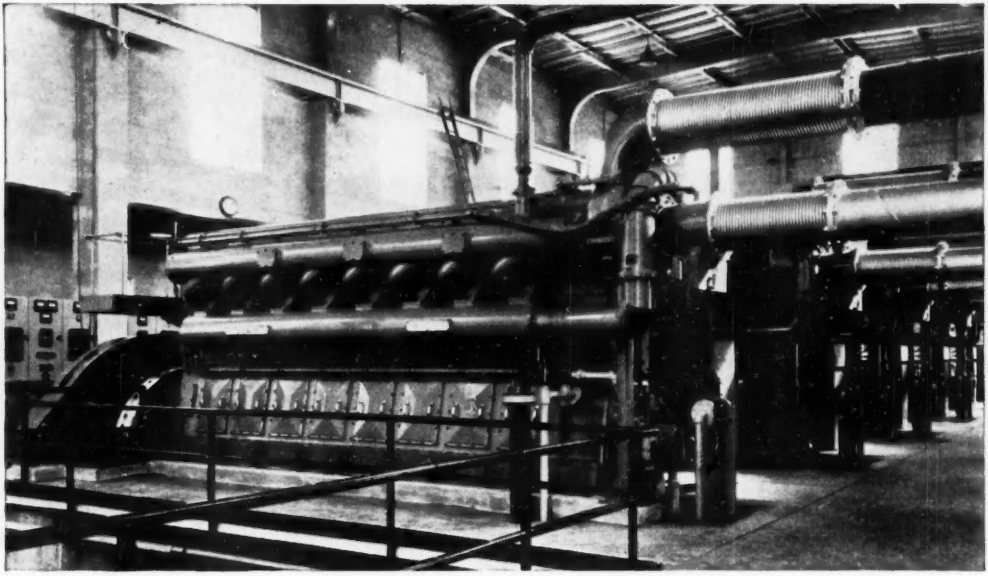
METALCLAD FOR OPERATING SAFETY

Bus run enclosures protect against accidental contact with buses by operating personnel.

INSPECTION SIMPLIFIED

Rectangular enclosures with easily removable flat covers or hinged doors make inspection easy.

ELECTRIC POWER EQUIPMENT CORP.
412 North 18th St., Philadelphia 30, Pa.



SUPERIOR has been elected *Again!*

Superior Diesels are being used for more and more installations where a dependable source of power is important. Like the North Carolina town that recently built a power plant to meet its expanding industrial and domestic requirements. Five supercharged, model 80-GX-8 Superior Diesels driving 1,000 KW generators were chosen to power this important new plant.

There are some good reasons for this constantly growing acceptance. Superior Diesels are economical to operate and maintain. And they provide top performance day-after-day because of the following features:

Conservative Ratings • Efficient Pressure Lubrication • Clean Combustion • Precision Bearings • Heavy Rigid Crankshafts • Strong Bases and Cylinder Blocks • Proved Roller Chain Camshaft Drives • Oil Cooled Pistons. We will be glad to send you a fully illustrated booklet that tells how these features can help you.

THE NATIONAL SUPPLY COMPANY
SUPERIOR ENGINE DIVISION
Plant and General Sales Office: Springfield, Ohio

THE NATIONAL SUPPLY COMPANY NSCO

Superior DIESEL

MALLORY
D-54* CONTACTS
Put the "lift" into Electric Lift Trucks

Almost human, today's electric lift trucks push, pull, lift, turn and stack with speed, smoothness and dependability. And mark well that word "dependability". These work horses of the factory and loading platform have to be tough . . . to keep at it month in and month out.

Their makers are mighty particular about what goes into them. So they specify Mallory D-54 Contacts to activate the controls. D-54 is tough. Many contacts made of this Mallory-developed material have operated more than 150,000 times . . . and still show practically no signs of wear.

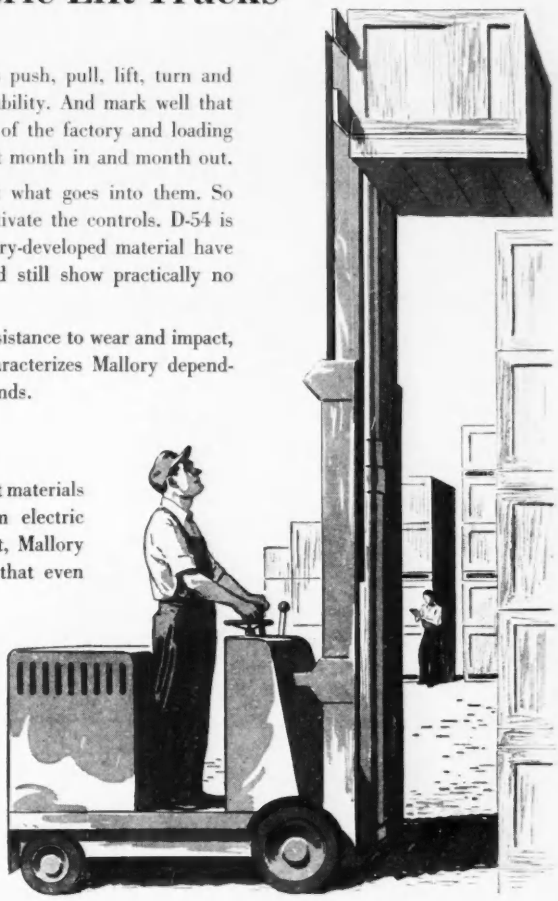
D-54 has the hardness, the conductivity, resistance to wear and impact, to erosion by arcing, to sticking that characterizes Mallory dependability . . . and that modern industry demands.

What's Your Problem?

D-54 is one of many types of Mallory contact materials —types which range in application from electric razors to city street lighting units. In fact, Mallory has designed so many types of contacts that even if you have an unusual problem you're likely to find a standard Mallory contact to solve it. If not — Mallory engineers are equipped to develop one to meet your requirements.

For all kinds of contact materials and service, you can't beat Mallory as a dependable, experienced source.

In Canada, made and sold by Johnson, Matthey & Mallory, Ltd., 110 Industry St., Toronto 15, Ontario



Electrical Contacts and Contact Assemblies

P. R. MALLORY & CO. Inc.

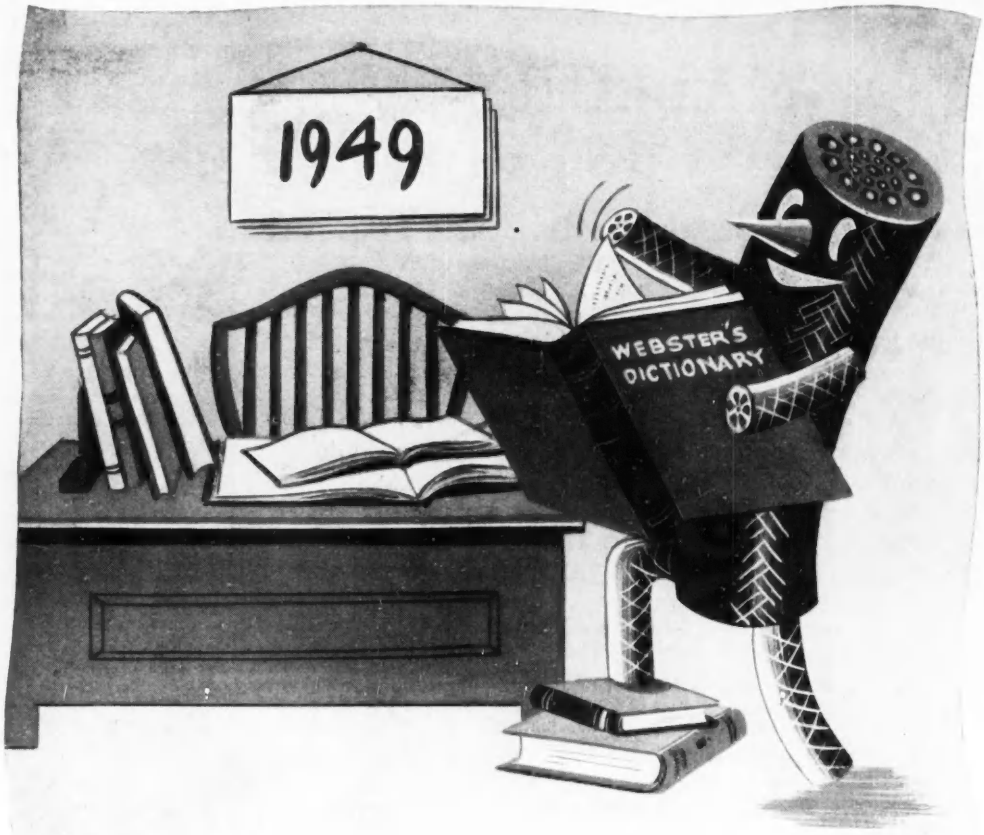
MALLORY

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

SERVING INDUSTRY WITH

Capacitors — Rectifiers
Contacts — Switches
Controls — Vibrators
Power Supplies
Resistance Welding Materials

*Reg. U.S. Pat. Off.



How long is "long life"?

TIME is testing Kerite insulation. But *Time* cannot be hurried. We have a sample of Kerite cable that was made just after the Chicago fire—and the insulation is still in first-class condition—both electrically and mechanically. After nearly 70 years, the dielectric strength is still excellent.

We don't know how long Kerite insulation will last—because our nearly 100 years is not long enough to find out.

But we do know that Kerite insulation gives remarkably long service at *remarkably low cost per year.*

Low maintenance, of course, goes right along with long life and dependable service . . . and that saves you money, too. Ask any Kerite user.

The Kerite we use today is the same that has withstood the test of time. Kerite engineers will be glad to help *you* take full advantage of its properties. Kerite insulated wire and cable is made for a full range of voltage ratings—and for aerial, surface, underground, or submarine applications, both indoors and outdoors. *The Kerite Company, 30 Church Street, New York 7, N. Y.*

Offices also at: 122 So. Michigan Avenue, Chicago; 582 Market Street, San Francisco; 714 W. Olympic Blvd., Los Angeles.

Kerite Insulation—Your Cable's Best Life Insurance

KERITE CABLE

Obsolescence

UNTIL THE electric utilities add the necessary capacity to afford a modest but comfortable amount of reserve, there is not likely to be a lusty program of replacement of obsolete and inefficient equipment. But the day for *thinking* about the situation and for including the early steps in the budgets and plans is already in sight. For one utility—Niagara Hudson—it is not only in sight but was a $26,000,000 item of testimony in the SEC hearings on a proposed consolidation of cross-state-units in New York. For others, there are several good reasons for not putting off the question of obsolescence indefinitely.

Costs of maintenance of equipment have, on the whole, risen even more than the costs of new construction. It's poor business to let an antique "eat its head off" in upkeep. The only possible excuses are that either the unit cannot be spared or there is no money to buy an economically operable replacement.

Rising costs of operation have brought both manpower and fuel into sharp relief. Modern turbogenerators, modern boilers, modern substations, modern meters take less operating attention and either use or waste less energy. A careful study probably will show that it does not pay to keep their early-vintage predecessors in service.

These two add up to a third factor that may come from without rather than from within the industry. It would not be surprising if the regulatory authorities should ask somewhat embarrassing questions along these lines when matters of rate increases, security issues, and corporate simplification come before them. In the Niagara Hudson instance the common-sense acknowledgment came from J. E. Moore of Ebasco Services in his support of the consolidation move. The argument might as readily have been injected by SEC.

In the Consolidated Edison rate case the Commission engineers testified that the company's $150 million depreciation reserve was $96 million short of what it should be for a $750 million undepreciated total.

If the regulatory bodies should raise the question, it would be incumbent on them to facilitate finding the wherewithal and equally incumbent not to force the scrapping and write-off of used and useful facilities. There comes to mind the pressure of the ICC in the middle '30's to have the Pennsylvania Railroad scrap the dozens of steam locomotives that stood in rusting lines on so many side-tracks. Before they were dismantled, Hitler rattled the sword, and the engines disappeared from the sidings as fast as the Altoona shops could rehabilitate and reinstate them. Their timely availability helped the railroads carry warriors and war freight in a way that made proud reading later.

No one wants to see utility plants or systems stripped of back-up facilities for any emergency, but there is a happy medium between security and downright profitableness. In that intermediate band lie a variegated array of equipments and lines that have outlived their earnings capacity or ability to cope with current economic factors. The program for displacing them should be set down on paper now, with determination to execute the program as fast as plain safety permits.

Highway Snow Melting

THERE ARE about 3,250,000 miles of avenues, highways, streets, and lanes in the United States. Of these 3,009,000 are rural and less than 250,000 are in the cities and major towns. In the cities alone there are just about 100,000 miles of street with hard-surface pavement. How much energy and generating capacity would it take to keep each of those mileages free of ice and snow by electrical means?

Well, the City of Detroit installed a thawing mesh under each of the two opposite traffic lanes along a 500-ft stretch of street, and the results give some clue to the query. Detroit found that it took an average of 40 kw to melt a 4-in. fall and prevent ice formation. For a mile it would be about 420 kw. For the paved streets of American cities it would take 42,000,000 kw, about equal to the total installed capacity a few years ago. To make snow removal and ice prevention by prevailing methods unnecessary for *all* the streets of the cities, paved and unpaved, would take practically 100,000,000 kw of installed generating, line, and transformer capacity. While this capacity would be devoted to the storm service *every* other service would have to be suspended. To take care of the 600,000 miles of state and federal highways would take well over 500,000,000 kw.

Installation cost and investment would be high and the use factor very low in hours per year. It does not seem that street warming, snow melting, and ice thawing are projects in which the utilities are likely to be interested. Limited, local situations like heavy-traffic pedestrian crossings or walkways may be more feasible.

Half-Century Challenge

THE MASSACHUSETTS Institute of Technology's Mid-Century Convocation of Scientific Progress has come and gone. Synchronized with the inauguration of Dr James R. Killian, Jr, as tenth MIT president, this great meeting of minds set a new milestone in the history of engineering education. Winston Churchill crossed the ocean to illuminate the proceedings with inimitable mastery of speech enriched by his unparalleled leadership in days and nights when civilization hung at the edge of the abyss. Scientists, educators, philosophers, and publicists from all points of the compass journeyed to Massachusetts to participate. Under skies still heavy with threatening clouds of peril, these leaders grappled courageously with the unsolved issues of the oncoming half-century and found rays of hope amid the stark realism of the so-called cold war.

No one claimed "to know the answers," but it is clear that the scientist and the engineer will be imperatively needed in the years ahead. Research and basic technical education must carry on and increase. Graduate work must expand vastly. The humanities must be far more widely and deeply cultivated in technical institutions. The world cries out for wider outlook, larger understanding of history, government, and sociology. Free enterprise must support free institutions. Out of a new awareness of world conditions, of their impact on nations and individuals seeking to rise from wretched existence to some fulness of life, science must achieve progress in remedying evil results of ignorance and tyranny. In defense of liberty and opportunity for all sorts and conditions of men, science agrees and accepts the challenge.

Important Public Information

ONE RULE of thumb observation about electric utilities as employers is that you don't get paid too well, but the work is steady. Thanks to the Bureau of Labor Statistics, the refutation of part of this ancient belief is at hand.

According to a BLS survey that may or may not have included the effects of the "third-round" of wage increases, (ELECTRICAL WORLD, November 13, page 5) it is apparent that the wages of plant workers, at least, average higher in the power business than they do in manufacturing industries. Straight-time wage rates paid by utilities to plant workers, according to the BLS findings, average $1.35 per hr. In manufacturing industries, the comparable rate is $1.29. That's a 4.6% difference. It's not unimpressive when it's coupled with the well-known stability of employment which electric utility work offers. And it becomes even more attractive when the benefits which are so common among utilties are thought of—the insurance and pension plans, sick leaves, vacations and holidays with pay.

This BLS survey is what we'd call live news for the men in electric utilities who are spending an increasing amount of time on the promotion of employee relations. It certainly is a favorable story and it comes from a source which the unions regard as being entirely official. Aside from the employees, we'd guess that the stockholders would find it of great interest to learn that the companies in which they've invested are at the head of the parade. For one of the greatest threats today to the industry is the labor dispute. This is true whether it takes its effect in a strike, a slowdown, or bad worker morale.

Yes, individual systems may choose to make known the fact that the industry is out in front on wage rates. We'd guess this is one part of a public information program to which even the most reluctant operating utility executive could agree.

Equal Justice Under Law?

IT'S HARD for a layman to argue legalisms with the United States Supreme Court. So, if the high bench holds, as it has, that a mere taxpayer has no right to bring suit testing constitutionality of an act, one can only acquiesce. No such difficulty impedes questioning of Congress' refusal to bestow the right of appeal, as it did on the New Johnsonville item last week. Unorthodox the request might have been. But no citizen rates a denial of access to the courts.

The Electrical Week

Electric utilities are paying more attention to their annual reports. A survey of those received by ELECTRICAL WORLD shows that more reports are being published in color and that more attention is being given to illustrating them . . . The Interior Department apparently is ready to fight to the finish to gain control of all streams in which the federal government has, or proposes to build, hydroelectric projects. Latest move is to petition FPC for status as a formal intervenor in a case involving the Virginia Electric & Power Co . . . Dramatization of service to the public was stressed as the Southeastern Electric Exchange held its annual meeting at Boca Raton . . . And in Washington, legislation providing for a Columbia Valley Administration has been introduced in both Houses, but even its most ardent supporters do not look for its passage this year.

There is a move underway in Washington to subject to a referendum the recently enacted legislation allowing two or more PUD's to acquire property of private utilities in the state.

There isn't any action in sight for several months on cutting or junking wartime excise taxes. Congress isn't eager to reduce government revenues at a time when there's a lot of debate about an unbalanced budget and substantial tax increases. Even if the House Ways and Means Committee took up an excise tax bill now, it's virtually certain that nothing would be accomplished which actually would reduce or eliminate excise revenues for some time.

At hearings on the American-Slav Congress, House Un-American Activities Committee members expect to produce proof of Communist Party membership on the part of CIO electrical workers in defense plants.

Electric utilities are using more oil. January usage of 5,356,290 bbl was highest of record. 0.9% higher than the previous record set in December, 1946.

The four Almno system companies, all in the Middle South, have agreed to standardize the design of the generating stations they will build in the near future.

Rural Electrification Administrator Wickard still insists that five years is the maximum period for which an REA-financed distribution co-op should contract for wholesale power supply. It's a major point of disagreement between REA people and the utility industry. Wickard's arguments are backed by the fiscal 1950 Agriculture Department Appropriation Bill, containing half a billion in new loan funds for REA. That will build a lot of generating plants, the agency figures, if it cannot get the kind of energy supply contracts it wants.

Nothing New Dept—When Governor Warren's bill doubling the state tax on utilities went before the Florida Senate, a following measure was one to exempt municipalities owning utilities from the state tax.

Life's Like That Dept.—When electric and gas employees of South Carolina Electric & Gas Co went out on strike, residents of Columbia found that electric and gas services were unaffected. However, they couldn't ride a bus anywhere in the city because the bus drivers wouldn't cross the picket lines.

A survey of available business office and retail space by the National Association of Real Estate Boards shows that property taxes are expected to rise this year in 77% of the 505 cities covered.

A cynical employee of an Eastern electric utility has this report on the television receiver market. "The spenders will buy them even if they have to go into debt. The conservatives will follow on behind as they always do."

London reports that a British aviator flew a jet plane through a high-voltage power line at 500 miles per hour and lived. Furthermore, "he brought the plane back safely to base only slightly damaged." Doubtless, one of their transmission lines failed to return.

Notes From The News

Illuminating engineers of the Southwest were told by C. M. Cutler, Cleveland, to learn more about color, how to use it, and the effect it has on people . . . The Wyoming Historical Landmark Commission will erect a plaque near the site where Thomas A. Edison got his idea for the first successful incandescent lamp filament. He was fishing at Battle Lake when his fishing pod suggested to him the use of bamboo . . . Improved water conditions brought hydro production of the New England Electric System to 371 million kwhr in the first quarter, an increase of 149 million over the first quarter of 1948 . . . New Johnsonville,

Continued on following page

where TVA will erect its steam plant, is so-called because its first inhabitants came from Johnsonville when it was flooded out by TVA's Kentucky Lake . . . So successful have been the efforts of the Business Paper Advisory Committee to increase the flow of heavy iron and steel scrap that the drive for scrap will end May 15, a month and a half sooner than expected.

Niagara Falls is illuminated on a full-time basis for the first time since the war. The twin cities of Niagara Falls, N. Y., and Niagara Falls, Ont., have appropriated lighting funds for one year. . . . More than 4,500 Georgians are taking part in agricultural improvement projects sponsored by Georgia Power Co in cooperation with 4-H clubs, the Future Farmers of America, the state division of vocational agriculture, and REA co-ops. More than 32,000 acres have been planted in the program. . . . FPC estimates power requirements for 1970 in the portion of the Missouri River Basin comprising most of Montana, Yellowstone National Park, and a small section of Idaho at 3.9 billion kwhr with a peak demand of approximately 640,000 kw—about double the 1946 needs. The report calls for approximately 296,000 kw of new capacity by 1970, with 12,000 kw of that required by 1950.

Legislation:

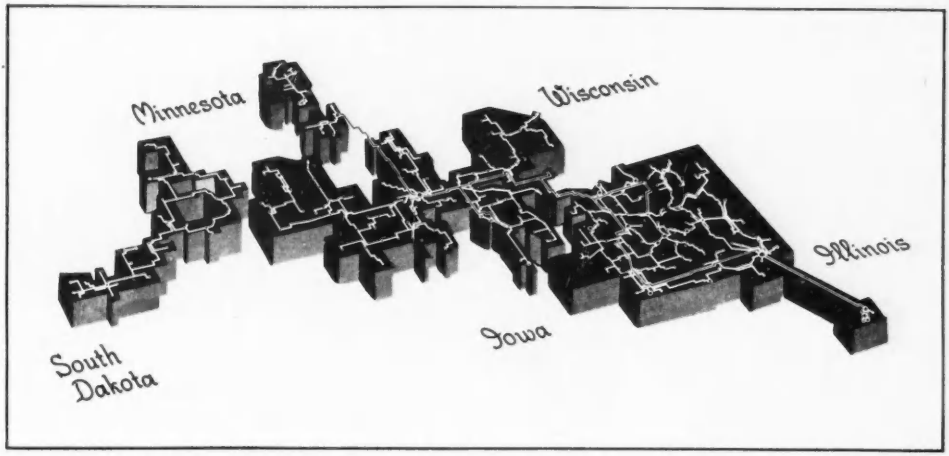
A second legislative attempt to prevent construction of a $12 million privately owned power plant on the Deschutes River in central Oregon failed when the state Senate voted down creation of an interim committee to study the whole question of dams on the lower Columbia River and its tributaries. Passage of the resolution would have delayed at least two years the construction of the Pelton Dam by the Northwest Power Supply Co, a corporation sponsored by three northwest utilities . . . A Texas Senate bill requiring cooperatives to pay tax and license fees equal to those paid by private firms in the same business has been ruled unconstitutional by the attorney general. He said revenue-raising action belonged solely to the House of Representatives . . . State regulation of Florida electric and gas companies is proposed in a bill now before the Legislature. The State Railroad and Public Utilities Commission would get broad authority to set rates, regulate services and safety, test meters, force repairs and improvements to plants, and generally fix rules. Cities and co-ops would be exempt.

An Illinois bill prohibits resale of gas and electricity in cities with a population of 100,000 or more except at the price fixed by law for a like sale by a public utility corporation and except through a meter. . . . Doubling of South Carolina's tax on privately generated electricity is asked in a bill now before the Legislature. The ½-mill-per-kwhr tax on power produced in South Carolina or transmitted into the state would be raised to one mill. . . . Several Ohio appliance-dealer organizations are supporting a bill to prohibit utility companies from selling appliances. Ohio Edison Co claims similar legislation has been judged unconstitutional in other states. . . . Another bill in Ohio's legislative hopper would abandon the reproduction cost method of valuing utility property and substitute original cost. Advocates argue that actual cost can be established with fair accuracy, while reproduction costs can only be estimated.

Financial:

Central Arizona Light & Power Co will sell $4 million in bonds to a syndicate of insurance companies. Proceeds will be used to retire a loan . . . Black Hills Power & Light Co has received Federal Power Commission authorization to issue $1.5 million in 3⅜% 30-year first mortgage bonds and $1 million in 3¾%, 25-year debentures. Purchaser will be the Equitable Life Assurance Society . . . The quarterly dividend rate on the Southern California Edison Co's common stock was increased from 37½¢ to 50¢ a share . . . Increases in authorization of Pacific Gas & Electric Co capital shares from 10 to 12 million common and 8 to 12 million preferred have been voted by stockholders . . . FPC has okayed issuance by Idaho Power Co of up to $4 million in common stock, $1 million in 4% preferred, and short-term bank notes aggregating $4 million in excess of the statutory exemption, which is 5% of the company's total capitalization . . . Stockholders of Empire District Electric Co have voted to increase authorized capital stock from 400,000 to 550,000 shares and to amend the charter so that the utility can offer shares to the public without first offering them to stockholders. The management said it has no plans for sale of additional stock.

Applications for stock sales and bond issues to finance part of Arkansas Power & Light Co's $23 million 1949 construction program have been approved by the Arkansas Public Service Commission. The company will sell 320,000 shares of common to Electric Power & Light Corp for $4 million and will issue $8,300,000 in 25-year sinking fund debentures. . . . Western Light & Telephone Co has won stockholder approval for increasing authorized common from 300,000 to 400,000 shares and preferred from 200,000 to 250,000 shares. . . . Otter Tail Power Co has received FPC authorization to issue $3 million in 3¼%, 30-year first mortgage bonds and to borrow amounts not to exceed $4 million at any time on short-term unsecured promissory notes. . . . New Jersey Power & Light Co's net income dropped 41% in 1948, from $1,135,000 for 1947 to $667,000. Principal cause was the extraordinary expenses incurred as a result of a sleet storm on Jan 1.



THREE-DIMENSIONAL effect is given Interstate Power Co's system map by use of perspective. Map above, taken from cover of 1948 annual report, is more elaborately interpreted on report's center spread. System stands on blocks above outline map of the region

1948 Annual Reports More Readable

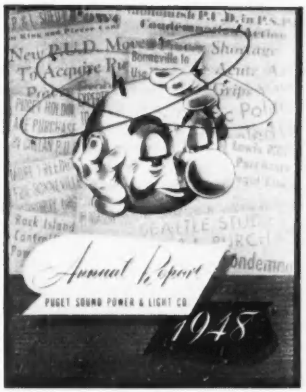
Use of Color, Illustrations Brightens Utility Accounts of Stewardship; Broadened Content Indicates More Attention Paid to Stockholders' Needs

THE PUBLIC-RELATIONS-CONSCIOUS, who long have been plugging for lively, readable annual reports, can find plenty of evidence this spring that their seeds have taken root in electric utility soil.

Analysis of 44 utility annual reports indicates that management's concern for cultivating stockholder interest and understanding has flowered since the days of unadorned statistical statements. Content, style of presentation, and handling of figures show the effect of studies from the public relations angle.

Content, in most of the reports studied, has branched out to include a variety of topics with which the stockholder should be concerned. Most of the reports gave at least a passing nod to expansion programs, rates, analysis of ownership, taxes, government regulation, and employee relations.

Fifteen of the reports listed highlights of the year's operation on a special page, and 18 ran a "state of the union" message from the president. Thirty-one used a system map to show the company's scope, and 28 covered 1948 relations with employees. Only 11, however, summarized the utility's future outlook, and only four outlined company policies. Both of these topics Ebasco Services has found important to stockholders.



MENACED by public power encroachment, Puget Sound Power & Light Co projects this headache onto the front cover of its 1948 annual report. Whole report stresses this theme

In a two-color graph, Florida Power Corp, St. Petersburg, compared its 10-year progress with that of the electric power industry as a whole. The highlights of 1948 were split into favorable and unfavorable developments.

Nervous about the public power threat, Puget Sound Power & Light Co, Seattle, made that issue the theme of its report, with a nine-page letter from the president on the subject and anti-public power arguments woven into almost every page of text. Instead of its own system, Puget Sound mapped public power systems in Washington.

Louisville (Ky.) Gas & Electric's report celebrated the company's anniversary. Theme was "110 Years of Progress." A spread, illustrated with sketches, showed the utility's growth since gas lighting days.

Greatest strides were made in style of presentation, particularly in use of color. Ten of the reports had four-color covers, and only one stuck to black and white. Thirty-one used at least one additional color inside.

Houston (Tex.) Lighting & Power Co used 15 four-color pages besides the front and back covers. Four-color treatment was given the system map, several graphs, full-page photographs of Houston, and paintings of stations, equipment, processes, and applications. Four-color headlines were used for major divisions, even where no illustration appeared on the page.

Thirty-three reports put art work on the front cover and 17 on the back. The number of halftones used within the report ranged from 0 (ten reports) to 32, with the average about 10. Twenty-four companies went to the added ex-

pense of bleeding some halftones.

The average number of line cuts was about 7, with three reports using more than 20 and ten omitting them altogether. Thirty included one or more line graphs; ten used pie charts; and only 18 ignored bar graphs. Pictographs appeared in nine reports and cartoons, up to 18 in number, in 10.

Pictures of plant and equipment, the most popular subject, were used in 34 reports. Fifteen utilities illustrated processes and 12, applications of electric power.

Graphs Superimposed

Ohio Edison Co, Akron, enlivened its graphs by superimposing them on halftones or sketches related to the subject. A housewife with electric stove and refrigerator, for example, formed the background for a line graph of residential power use.

To get the personal touch recommended by Ebasco, ten companies pictured their officers, although only one included much biographical data. Several, notably Florida Power Corp ran pictures of employees and employee activities. Two pages of pictures in the Florida Power report boosted the state.

Wisconsin Power & Light Co's (Madison) organization of its book was unique. Colored tabs divided the report into four sections, each discussing a goal of the company. The goals, service to stockholders, customers, community, and employees, were listed on the cover.

Few Use Index

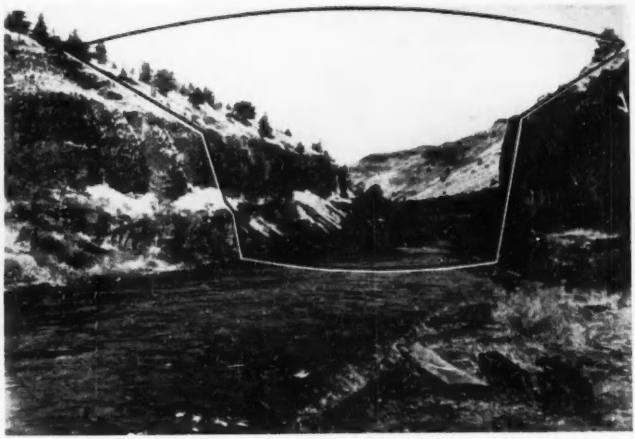
Only seven of the report studied guided the reader by an index or table of contents.

Dimensions ranged from 6x9¼ to 8½x11 in., with the latter by far the most common. The number of pages varied from 12 to 58—Ebasco's "Annual Report Tool-Kit" for 1948 sets 32 as maximum—with 20 most common and 26 average.

Practically every report stuck to the traditional long financial statement in the back. The statements ranged in length from three to 27 pages, with eight pages about average. Twenty-seven companies, however, also offered a one or two-page condensed form near the front.

Eight included ten-year statistical histories, and 29 gave comparative figures for less than 10 years, usually for 1947 and 1948.

Several, like Florida Power Corp, set up their shortened balance sheets informally, using such headings as "Our Income Came From," "What We Own," "What We Owe," with Reddy Kilowatt or other sketches.



IN THIS 800-FT canyon near Madras, Ore., the Northwest Power Supply Co proposes to erect a 112,500-kw hydro project. The river is the Deschutes. Outlined is the dam

Interior Fighting to Control Streams Where U. S. Has Hydro Projects

THE INTERIOR Department apparently is planning to fight to the finish in its bid for control of all streams in which the federal government has, or proposes to build, hydroelectric projects.

The Department has petitioned the Federal Power Commission for status as a formal intervenor in a case before FPC on private development of the Roanoke River in Virginia. The formal status would permit Interior to appeal any FPC decision on the Roanoke project. Should the matter be carried into the courts, private development of such streams might be effectively barred for years hence.

FPC's staff this week urged the Commission to bar formal intervention by the Department. The staff pointed out that Interior previously has intervened in license application cases informally, enjoying full privileges to protest such applications. This status, which hitherto satisfied the Department, should be sufficient in the case in point, Virginia Electric & Power Co's application to develop the Roanoke Rapids site, FPC's staff argued.

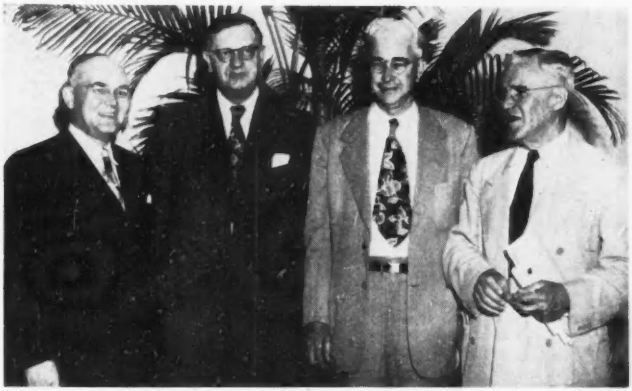
Vepco also protested Interior's petition for formal intervention. The company asserted the Department's move implied that FPC was incapable of protecting the public interest in hydro license cases. Never before, the company protested, had it been necessary for any federal agency other than FPC to safeguard U. S. interests.

Conceding that the Flood Control Act of 1944 gave Interior authority to market energy from any federal hydro plants built on the Roanoke, the company argued the Department should concern itself only with selling such power, not with construction of projects by private or federal agencies.

Interior originally contended that FPC had no authority to entertain Vepco's license application for the Roanoke Rapids project (EW, Apr 2, p 11). It based this argument on approval by Congress of plans of the Army Engineers for "comprehensive development" of the Roanoke in 1944. But FPC scheduled hearings in the matter for May 12. FPC staff members pointed out that Buggs Island Dam, being built 41 river miles upstream by the Army Engineers, was the only mainstream development of the Roanoke authorized and appropriated for by Congress.

Meanwhile, Vepco revised its plans for the project. The company advised FPC that it proposed to increase installed generating capacity from the original 98,000 hp to 125,000 hp. In addition, the company provided for deepening the project's tailrace. These changes reportedly were made on the advice of FPC engineers.

Several other utility companies have evinced interest in the case and may seek to intervene informally before the deadline on May 9.



NEW OFFICERS of the Southeastern Electric Exchange include C. B. McManus, left, president of Georgia Power Co, second vice-president; John W. Talley, executive secretary; W. O. Turner, president of Louisiana Power & Light Co, first vice-president; and J. E. S. Thorpe, president of the Nantahala Power & Light Co, retiring president. S. C. McMeekin, president of South Carolina Electric & Gas Co, new SEE president, was unable to attend the meeting

Dramatization of Service to Public Is Urged at Annual Meeting of SEE

No ELECTRIC UTILITY may regard its service area as an exclusive territory unless its customers believe that utility should serve them.

This was the message delivered by Pres J. E. S. Thorpe of the Southeastern Electric Exchange at the group's annual meeting Apr 13, 14, and 15 at the Boca Raton Club, Florida.

Thorpe, who is president of the Nantahala Power & Light Co, warned SEE members that the duty is theirs to convince customers that the latter's interest lies in obtaining electric service from private utility companies. The power industry, Thorpe added, must find a way of dramatizing the good service it renders comparable to the railroad and airline dramatizations of safety or to the Bell System's effective promotion.

Col H. S. Bennion, vice-president and managing director, Edison Electric Institute, discussed the industry leadership necessary to survive the engulfing movement toward national socialism. He pointed out that the danger to any industry lay in such defects as ineffective finances, bad leadership, faulty organization, poor price structures, poor sales planning, labor problems, or inability to meet new conditions. His prescription for the power industry: Exploit opportunities in selling and engineering, use more labor saving devices, meet all demands for service, retire old equipment, work together, and recognize the importance of the individual employee and his spirit.

Chester H. Lang, vice-president of General Electric Co, added several new requirements to the list of "musts" for the industry. These included better recruiting and expanded sales campaigns. Optimistically, Lang predicted that electric output could conceivably reach a trillion kwhr by 1955 or 1960 if the industry showed sufficient initiative.

Power developments here and abroad were described by Walker L. Cisler, executive vice-president, Detroit Edison Co. He called for the coordinated operation of the hydro and steam generating facilities of the country by private and public owners.

Albert H. Gordon, president of Kidder, Peabody & Co, pointed out the importance of the problem of common stock financing. He felt that the common stock market was improving, but that preferred stock could hardly be sold under present conditions at a reasonable dividend rate. He pointed out that common stocks sold in 1948 had an average dividend rate of 7.3%, those in 1947, 6.6%, and 1946, 5.1%.

In speaking of the future of the electric utility industry, A. F. Tegen, president of General Public Utilities Corp, saw no harm in the present high dividend rates on preferred stock and said he believed that earnings and dividends on common stock must be increased to finance the expansion program. He, like the others, stressed the need for informing the public and suggested that companies show how wisely utility income is divided among stockholders, management, employees, and reserves.

Gwilym A. Price, president of Westinghouse Electric Corp, showed how important incentives were to the success of the American system. He advocated tax reforms to increase incentives by placing a ceiling on personal income tax of 50% and eliminating double taxation. His further prescription was for industry to keep government out of business, to stop government drive for more controls, and constantly to strive to explain the profit system.

Demand charges for large residential consumers were suggested as the most likely solution of the rate problems pertaining to these customers by L. R. Lefferson, manager Rate Department, Ebasco Services Inc. Emphatically, Don G. Mitchell, president of Sylvania Electric Products, Inc, proposed a more vigorous selling program than anything yet conceived by the industry.

At the closing session, the following officers were elected: President, S. C. McMeekin, president, South Carolina Electric & Gas Co; first vice-president, W. O. Turner, president, Louisiana Power & Light Co; second vice-president, C. B. McManus, president, Georgia Power Co; and third vice-president, M. C. Funk, vice-president and general manager, Appalachian Electric Power Co.

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Brazilian Development Will Cost $220 Million

(McGraw-Hill World News)

Brazilian Traction, Light & Power Co, Toronto, Can., plans to spend more than $220 million in its 1947-1951 development program in Brazil.

Major undertaking is completion of the Paraiba-Pirai diversion, whereby water will be pushed uphill through a series of dams, pumping stations, tunnels, and a canal to increase electricity supply for Rio de Janeiro and Sao Paulo.

The Morrison-Knudsen Co, an American firm, is resuming work on that job, interrupted at the end of 1947 when financing was doubtful. Subsequently, the World Bank approved a $75-million loan to Brazilian Traction, and the Brazilian government guaranteed it.

Other expenditures in the five-year program include improvement of the light, power, streetcar, and telephone systems in Rio de Janeiro and Sao Paulo.

HEAD TABLE of New England Rural Electrification Institute banquet was occupied by H. W. Jennings, seated left, treasurer, Roland Hess, commercial manager, and Harold F. Schnurle, vice-president, Central Maine Power Co; Dr Arthur A. Hauck, president, University of Maine; L. H. Alline, president, Maine Public Service Co; Carl Smith, assistant to the president, Bangor & Aroostock RR; and Milton Allen, New England Council. Standing, G. L. Munroe, Narragansett Electric Co, new, and F. R. Bailey, retiring Institute chairman

Utility Challenges Seattle Appraisal of Properties

Puget Sound Power & Light Co values at $36,388,957 properties in the Seattle, Wash., competitive area which appraisers for the city had valued at $23,767,324. Pres Frank McLaughlin has informed the Seattle City Council.

McLaughlin placed no valuation on the White River and Snoqualmie hydroelectric plants, which the city would like to buy, nor on its Seattle steam heating system. Reason for the omission of figures on the hydroelectric plants is the condemnation actions begun against the plants by the City of Tacoma and the Kitsap PUD.

Puget Power's "reproduction cost new" figure of $44,339,404 for its Seattle area properties is only 2.5% above the estimate of the city's consultants, but the company figures depreciation at $7,950,447 as against the $19,640,154 allowed by the city.

"The city's engineers have greatly exaggerated the accrued depreciation that inheres in these properties," McLaughlin declared, and consequently "their estimate of reproduction cost less depreciation is unjustifiably low. For example, the city engineers estimated that the Georgetown steam plant in 1948 had a present condition of 23.3%. They estimate the percent condition for distribution structures and improvements at 46.4%, overhead conductors and devices at 56.1%, line transformers at 43.2%, services at 57.8%, and meters at 37%. These estimates of percentage conditions are in our opinion very wide of the mark. Company consultants give the Georgetown steam plant a 50% value."

The company engineers' estimate does not include any allowance for organization and other intangibles, going concern value, or severance damages, McLaughlin pointed out.

"We feel sure that it would be advantageous in effectuating a reconciliation between the widely divergent depreciation estimates if arrangements could be made for our engineers and the city's to meet together for the purpose of detailed discussions and clarification of methods used," McLaughlin proposed.

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Dewey Smooths Way for St. Lawrence Power

Governor Dewey has not given up his campaign to have the New York Power Authority construct a hydroelectric project on the St. Lawrence. This week (Apr 19) he approved legislation that will broaden the powers of the Authority to handle the project.

The bill signed by the governor removes a former restriction that the Authority have firm contracts for the disposition of its electric energy before issuing bonds. The new act also gives the Authority the power to rent, buy, or erect transmission lines. It had been believed that the construction of the St. Lawrence project would lead to a concentration of industry in that area. Now the power would be made available throughout the state.

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Utility Strike Continues

The strike of IBEW employees of the South Carolina Electric & Gas Co entered its tenth day (Apr 20) without change. No negotiations to settle the strike were in progress. Supervisory employees were having no difficulty in providing full service.

Widening Electricity Use Features Farm Institute

Widening perspectives for utility service and power equipment use on farms featured last week's tenth annual New England Rural Electrification Institute. More than 100 members and guests attended the meeting at the University of Maine.

In the various sessions emphasis was laid upon more selective lighting, heating, and power uses. Rural line extensions establish bases for wider service. Informal discussions, off the record, indicated it was unwise even to consider curtailing utility expansion in this type of load building once farms in an area are provided with service.

Fluorescent lighting, it was reported, is making progress for lighting areas where potato grading is done as well as in the kitchen. The use of infra-red heating is spreading into the dairy barn. More research is needed in the economic aspects of purchased power supply and distribution for competitive pumping of water. Engineering details are lacking for specific installations.

Study of the economic areas of single-phase against three-phase line extensions as farm loads grow was urged by several speakers. Encouraging progress was noted in refrigeration and in ventilation of poultry houses and potato storage buildings. In a representative case an air supply of 1 cfm per 4 bbl of stored potatoes worked well. Germicidal lamps are coming into wider use on farms.

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Town Renews Franchise

Iowa Public Service Co's power franchise has been renewed for 25 years by voters of Galva, Iowa.

A VAST ARRAY of merchandise greeted the thousands of visitors who attended the Electric Show sponsored by the Electric League of Chattanooga during the first week of April

CVA Getting Nowhere in Congress; Backers Expect No Action in 1949

PRESIDENT TRUMAN'S proposal to set up a TVA-type regional authority in the Columbia River Basin is not going anywhere during the present session of Congress.

Reps Hugh B. Mitchell and Henry M. Jackson, Washington Democrats, introduced legislation authorizing a CVA last week (Apr 14). The measure was drafted by an inter-agency team, headed by Presidential Assistant Charles Murphy and Assistant Secretary of Interior C. Girard Davidson. It went to the Public Works Committee, which appeared more interested in other business.

Senator Magnuson, Washington Democrat, introduced identical legislation in the Senate this week. But the prospects for early hearings seemed as dim there as in the House. Barring a special session of Congress later this year, CVA backers themselves look for no action on the bills before 1950.

The President's proposal, as introduced in Congress, calls for establishment of a Columbia Valley Administration—"authority" is an unpopular term, the sponsors explain. The new agency, initially at least, would take over the Columbia Basin plans, programs, and staffs of the Bureau of Reclamation, Bonneville Power Administration, and the Army Engineers. The Engineers, however, would continue their work on channel and harbor improvement in tidal waters of the region. CVA would be directed to cooperate with other federal agencies, taking part in planning programs of the Forest and Soil Conservation Services, the Bureau of Mines, and others.

The CVA, as proposed, looks pretty much like the Tennessee Valley Authority of today. Chief functions of the new agency are defined as planning, construction, and operation of navigation, flood control, conservation, and reclamation projects and facilities for "the generation, transmission, and disposition of electric energy."

Chief differences in the TVA and CVA set-ups center about the following points:

Areas covered—CVA would direct resource development in the basins of the Columbia and all its tributaries. This would include most of Washington, Oregon and Idaho, western Montana, the Snake River Basin in northwestern Wyoming, and the upper reaches of the Owyhee River in northern Nevada. Thus, CVA would cover some 269,000 square miles in six states, as compared with TVA's 40,000 square miles chiefly in one state.

Electric power activities — CVA's authority to build and operate projects, as defined by the present bills, includes the specific right to construct "standby facilities." Thus, CVA probably would avoid any controversy such as TVA's recent fight for the New Johnsonville steam generating plant. Major generating and transmission projects would be "approved" in advance—or rejected —by Congress as it acted upon the agency's annual budget. CVA also would be expressly authorized to set its own power rates, including a single, area-wide "postage stamp" rate. It would keep its power books according to procedures approved by the Federal Power Commission.

Local cooperation—CVA would consult local governmental, industry, and labor interests through advisory committees. But these would have no real authority, might be ignored by CVA's three $17,500-a-year directors. The legislation provides for the inviolability of existing water rights granted under state laws and forbids conflict with state laws.

Property acquisitions—CVA could not acquire any land or power plants by condemnation, except property immediately adjacent to an authorized construction project. But it could buy up power systems, selling the distribution systems as rapidly as possible to public bodies or cooperatives. It could even operate acquired distribution facilities "temporarily."

CVA would be financed by a special fund established in the U. S. Treasury. This would be fed by Congressional appropriations and returns from CVA's revenue-producing activities (power, city water, irrigation). The agency would retain enough of its revenues for operation, maintenance, and other working capital requirements.

It would arrive at its own allocations of costs, subject to approval only by the President and Congress, and pay the Treasury interest on power and municipal water revenues. Irrigation water would be supplied farmers without interest. The agency would be directed to make payments in lieu of taxes to states and local governments, but it would have wide latitude in determining the amounts to be paid.

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Portland GE Increases Wages in IBEW Contract

A new contract between Portland General Electric Co and Local 125, International Brotherhood of Electrical Workers, provides for a general pay increase of 5.15¢, plus an extra 5¢ an hour for linemen, wiremen, and cable splicers. The one-year contract is retroactive to Mar 1.

Journeyman linemen's base pay will be $2.13 an hour, up 15¢. Workers with 15 or more years continuous service with the company will get three instead of two weeks' vacation with pay. The new agreement marks the 34th consecutive year of strike-free relations between Portland GE and its employees.

Sho-Me Gets Loan While Waiting for SPA Power

The Sho-Me Power Corp has a new federal loan to build up its transmission system, in part at least, against the day when it will receive much of its energy requirements from the Southwestern Power Administration. But it still looks as if the Marshfield, Mo., utility must wait another year for the bulk of the SPA power for which it has contracted.

Sho-Me, originally organized as a cooperative and financed by the Rural Electrification Administration, has contracted with SPA for 57,000 kw. Delivery of this energy awaits completion of a 66-kv substation at Norfork Dam by the Army Engineers. The latter facility is scheduled for operation in April, 1950.

Meanwhile, Sho-Me is receiving Norfork energy through an interim arrangement with Arkansas Power & Light Co. This deal provides the Missouri firm with only a small percentage of the energy to be delivered later under the SPA contracts, REA representatives reported. In addition, the energy is delivered through AP&L's 33-kv substation at Norfork, over a 66-kv transmission line built by SPA from Norfork to West Plains, Okla., and Sho-Me's 66-kv line from West Plains to Willow Springs, Okla. Both lines, covering a distance of 70 miles, are being operated at 33 kv.

REA recently approved a $2,600,000 loan to Sho-Me. The larger part of this sum will be used for construction of 115 miles of 69-kv and 52 miles of 34.5-kv transmission lines and 13 substations with a total capacity of 42,500 kva. The loan also provides for distribution facilities.

REA previously had granted Sho-Me loans totaling $4,615,000, including funds to acquire and rehabilitate properties of the Missouri Electric Power Co. Sho-Me supplies energy at wholesale to eight REA-financed distribution cooperatives and to five municipal electric systems.

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Co-op Contracts Let

The M&A Electric Power Cooperative has let some contracts for equipment to be used in a 10,000-kw generating plant. REA allocated funds for the project in May, 1948, but the site of the plant has since been changed from Essex to Poplar Bluff, Mo. The plant will provide power for the Ozark Border Electric Cooperative of Poplar Bluff, the Scott-New Madrid-Mississippi Cooperative of Sikeston, and the Black River Electric Cooperative of Ironton.

SEC RULINGS

OHIO POWER Co and West Penn Power Co have received authorization to advance $200,000 each on open account, without interest, to Beech Bottom Power Co, Inc, for working capital purposes. All of Beech Bottom's 6,700 shares of outstanding common stock are held in equal amounts by the two companies. (Release No. 8933).

PUBLIC SERVICE CORP of New Jersey has ceased to be a holding company under an order issued by the commission. A plan for dissolution of Public Service, approved by the commission and the U. S. District Court for the District of New Jersey, became effective July 1, 1948. After making the transfers of assets and distribution of securities contemplated by the plan, the company was dissolved July 15, 1948. (Release No. 8934).

STANDARD GAS & ELECTRIC Co's proposed sale and transfer of 364,684 shares of common stock, without par value, of Northern States Power Co, a Minnesota corporation, as heretofore authorized by the commission, have been ruled necessary or appropriate to the integration or simplification of the holding company system of which Standard Gas & Electric Co is a member. Standard Gas & Electric Co is a holding company and a subsidiary of the Standard Power & Light Corp. (Release No. 8923).

WISCONSIN ELECTRIC POWER Co has been authorized to sell $10,000,000 of 30-year first mortgage bonds and to reduce the usual 10-day period for inviting bids to not less than six days. Proceeds will be used for capital outlays and other corporate purposes. The utility asked the commission to hold off action on request for permission to offer 266,093 additional $10 par common shares for subscription by stockholders until results of competitive bidding on bonds are learned. (Release No. 8926).

LONG ISLAND LIGHTING Co has received authorization to undertake negotiations for the private sale to insurance companies and other institutional investors of $16,000,000 of sinking fund debentures due 1969, the commission reserving jurisdiction over the interest rate and price to be agreed upon in such negotiations. Proceeds would be used to pay off $5,974,000 of debentures and $10,000,000 of bank loans. (Release No. 8918).

DALLAS POWER & LIGHT Co has received authorization to sell its $10,000,000 of 30-year first mortgage bonds, subject to the results of competitive bidding. Proceeds are to be used to repay short-term borrowings from its parent, Texas Utilities Co, approximating $2,500,000, and for construction and other corporate purposes. (Release No. 8938).

MEETINGS

Edison Electric Institute—Engineering Committee, Edgewater Beach Hotel, Chicago, May 2-4. Meter and Service Committee, Hotel Somerset, Boston, Mass., May 4-6; Joint Meeting with Association of Edison Illuminating Companies Metering and Service Methods Committee, May 5; Purchasing and Stores Committee, Jefferson Hotel, St. Louis, May 9-11; Annual Meeting, Traymore Hotel, Atlantic City, May 31-June 2; Hydraulic Power Committee, Shirley Savoy Hotel, Denver, Colo., June 22-25.

★ Association of Iron and Steel Engineers—Annual Spring Conference, Lord Baltimore Hotel, Baltimore, Md., May 2-3.

National Electrical Wholesalers Association—Annual Convention, Netherland Plaza Hotel, Cincinnati, Ohio, May 2-6.

Indiana Electric Association — Annual Young Men's Utility Conference, Ipalco Hall, Indianapolis, May 2-3.

American Society of Mechanical Engineers—Spring Meeting, Hotel Mohican, New London, Conn., May 2-4.

Missouri Association of Public Utilities — Annual Convention, Muehlebach Hotel, Kansas City, Mo., May 4-6.

Electrochemical Society—Spring Meeting, Benjamin Franklin Hotel, Philadelphia, Pa., May 4-7.

Missouri Valley Electrical Association—Accounting Conference, May 5-6; Annual Meeting, May 17. All meetings at the Hotel President, Kansas City, Mo.

Southeastern Electric Exchange — Power Sales Conference, Henry Grady Hotel, Atlanta, Ga., May 5-6.

Pennsylvania Electric Association—Spring Meeting, Prime Movers Committee, William Penn Hotel, Pittsburgh, Pa., May 5-6; Transmission and Distribution Committee, Irem Temple Country Club, Dallas, Pa., May 12-13. Spring Meeting, Meter Committee, Abraham Lincoln Hotel, Reading, Pa., May 19-20.

Southeastern Industrial Power Conference — Sponsored by General Electric Co. and Southeastern Electric Exchange, Henry Grady Hotel, Atlanta, Ga., May 5-6.

Northwest Electric Light & Power Association—Business Development Section, Hotel Utah, Salt Lake City, May 9-11; Personnel Section, Benjamin Franklin Hotel, Seattle, Wash., May 25-27; Accounting & Business Practice Section, Vancouver Hotel, Vancouver, B. C., June 23-24.

American Public Power Association — Annual Convention, Fairmont Hotel, San Francisco, Calif., May 10-12.

Instrument Society of America—Spring Meeting, Royal York Hotel, Toronto, Canada, May 12-13.

National Fire Protection Association — Annual Meeting, Fairmont Hotel, San Francisco, Calif., May 16-19.

New Jersey Utilities Association—Spring Meeting, Seaview Country Club, Absecon, N. J., May 20.

Pacific Coast Electrical Association — Annual Meeting, Coronado Hotel, San Diego, Calif., May 25-27.

Public Utilities Advertising Association—Annual Meeting, Netherland Plaza Hotel, Cincinnati, Ohio, June 20-21.

American Institute of Electrical Engineers — Summer General Meeting, New Ocean House, Swampscott, Mass., June 20-24. Pacific General Meeting, Fairmont Hotel, San Francisco, Calif., August 23-26.

American Society for Engineering Education—Annual Convention, Rensselaer Polytechnic Institute, Troy, N. Y., June 20-24.

American Society for Testing Materials—Annual Meeting, Chalfonte-Haddon Hall Hotel, Atlantic City, June 27-July 1.

Canadian Electrical Association—Annual Meeting, Banff Springs Hotel, Banff, Alberta, Canada, June 28-30.

★ Additions this week.

State Seizure Promised If Vepco Plant Is Struck

Governor Tuck of Virginia is prepared to seize and operate the facilities of Virginia Electric & Power Co if the International Brotherhood of Electrical Workers carries out its threat to strike at midnight May 5.

Applying the state's 1947 anti-utility strike law, the governor has issued a seizure proclamation and designated the three members of the State Corporation Commission as his agents to operate Vepco plants if it becomes necessary. In 1946, before the present law was passed, Governor Tuck drafted 1,600 essential production and maintenance employees into the state's "unorganized militia" in order to prevent a strike by IBEW.

H. M. Ware, chairman of IBEW's Vepco locals, notified the governor of the union's strike intentions, as the law requires, after direct negotiations and conferences with the state's commissioner of labor failed to bring about a settlement.

The union seeks a general 15% wage increase for 2,500 maintenance and production workers. The company offered a 3% bonus on 1948 earnings.

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Energy Production Sets Record for January

Production of energy by electric utilities during January, 1949, totaled 25,570,170,000 kwhr, the Federal Power Commission reports. This is the highest January production total of record, exceeding the January, 1948, output by 6.7%. The total is, however, 0.5% below the record 25,687,915,000 kwhr produced in December, 1948.

Industrial production, including generation by railway and railroad plants, was 4,803,999,000 kwhr in January, an increase of 7.1% over the similar month last year. Combined utility and industrial production during January was 6.8% above the similar month last year and for the year ended Jan 31, 1949, was 9.2% above the similar period a year earlier.

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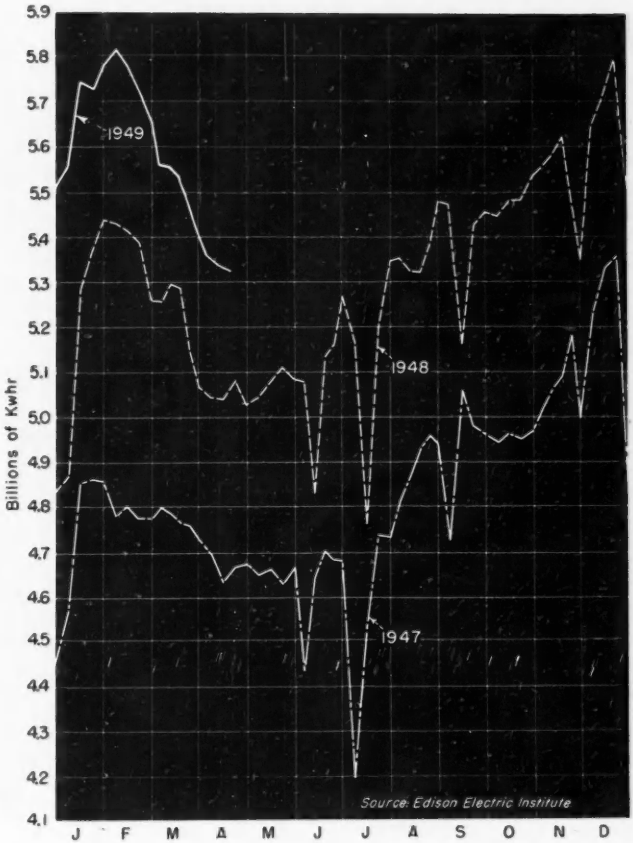
To Build 100,000-Hp Plant

Carolina Power & Light Co plans construction of a 100,000-hp steam-electric generating plant near Goldsboro, N. C. Construction will start this year and be completed in 1951. The plant will be located about five miles southwest of Goldsboro on the Neuse River.



Output Percent Change Drops to 5.0

The downward trend which has characterized the movement of the output curve for the past two months was not halted during the week ended Apr 16, 1949, according to figures released by the Edison Electric Institute. The amount of electrical energy distributed totaled 5,342,731,000 kwhr, comparing with 5,359,961,000 kwhr for the preceding week.

During the corresponding week last year, ended on Apr 17, the total output amounted to 5,086,826,000 kwhr, this year's figure representing an increase of only 5.0%. The percent change from the previous year for the week ended Apr 9 was an increase of 6.5%.

The feature of the regional changes was the entrance of the Mid-Atlantic States into the minus column with a percentage decrease of 2.3, compared with a 1.2% increase for the week ended Apr 9. The New England group remained in the minus column, but with a greater drop, 3.8% as compared with a decrease of only 1.2% the previous week. The Rocky Mountain States regained first place.

Weekly Output, Millions Kwhr

1949		1948		1947	
Apr 16	5,343	Apr 17	5,087	Apr 19	4,660
Apr 9	5,360	Apr 10	5,033	Apr 12	4,620
Apr 2	5,378	Apr 3	5,037	Apr 5	4,693
Mar 26	5,404	Mar 27	5,065	Mar 29	4,729
Mar 19	5,496	Mar 20	5,145	Mar 22	4,759
Mar 12	5,531	Mar 13	5,285	Mar 15	4,764
Mar 5	5,552	Mar 6	5,293	Mar 8	4,787
Feb 26	5,559	Feb 28	5,252	Mar 1	4,797
Feb 19	5,650	Feb 21	5,254	Feb 22	4,778
Feb 12	5,722	Feb 14	5,385	Feb 15	4,778
Feb 5	5,778	Feb 7	5,412	Feb 8	4,801
Jan 29	5,810	Jan 31	5,429	Feb 1	4,777

Percent Change from Previous Year

	Apr 16	Apr 9	Apr 2
New England	− 3.8	− 1.2	− 3.1
Mid-Atlantic	− 2.3	+ 1.2	+ 1.6
Central Industrial	+ 4.5	+ 6.3	+ 5.4
West Central	+10.4	+13.6	+12.4
Southeast	+ 8.9	+10.1	+10.6
South Central	+ 6.7	+ 5.0	+10.2
Rocky Mountain	+12.1	+12.6	+14.4
Pacific Coast	+11.0	+ 9.5	+10.5
Total United States	+ 5.0	+ 6.5	+ 6.8

WASHINGTON COMMENT

WILLIAM B. WHICHARD

INTERIOR DEPARTMENT evidently is serious about depriving the Federal Power Commission of a large chunk of its jurisdiction to license hydroelectric projects.

This move developed early in 1949, when Interior first began protesting Virginia Electric & Power Co's plans to develop the Roanoke Rapids site of the Roanoke River. If anyone thought the Department was fooling some months ago, that doubt should have been dispelled by Interior's more recent activities in the case. One of these was Secretary Krug's petition to FPC to participate in the Roanoke Rapids license proceedings before the Commission as a formal intervenor. The formal status would permit Interior to go to court if it did not approve FPC's decision on the Vepco application.

Should Interior take the decision into the courts, Vepco would be effectively barred from starting the Roanoke Rapids project during the litigation. More important, no utility company would be safe in planning private development of any stream on which the federal government was building, or planning, a hydro plant.

Interior's interest in the Vepco case stems from the Flood Control Act of 1944. That statute gave the Department authority to market energy from hydro plants built by the Army Engineers. The Engineers' Buggs Island project is being built 41 river miles up the Roanoke from the Roanoke Rapids site.

Secretary Krug first advised FPC that it had no authority to entertain Vepco's application for license of the Roanoke Rapids project. He based this argument on Congressional approval—also in 1944—of an Army plan for "comprehensive development" of the Roanoke Basin. The Army report recommended construction of a federal dam near the Roanoke Rapids site.

But FPC noted that Army reports on many streams have been "approved" by Congress. The fact remained that Congress had authorized and appropriated funds for only Buggs Island among the main-stream projects recommended in the Army report of 1944. Accordingly, the Commission ordered hearings on the Vepco license application starting May 12.

Significantly, Interior's petition to participate formally in the case did not repeat this contention that FPC had no jurisdiction. It pointed up instead Interior's statutory responsibility for marketing the Buggs Island energy. The Department could not make necessary advance plans, Interior argued, for selling Roanoke power if a private company was to share in the development of the stream.

But the jurisdictional implications are clear. The Federal Power Act set up FPC as the federal government's guardian of the nation's water power resources. The act provided for FPC consultation with other federal agencies in hydro license matters. And never before had anyone accused the Commission of ignoring interests of other government bureaus in such matters.

Interior has used its power marketing authority in the West, in connection with hydro projects of its own Reclamation Bureau as well as those of the Engineers, to justify transmission line construction. There is little doubt that the Department hopes to string nets of transmission lines around the Army's plants in the East. And it is not willing to rely on FPC to prevent utility companies from encroaching on this prospective Eastern power empire.

TECHNICAL NOTES

ARCHER E. KNOWLTON

Instruments now account for 10% of all processing plant capital expenditures. Industry has decided to measure rather than to guess.

Shorting contactors often avoid the installation of an oil switch or recloser to protect any part of a distribution circuit presenting low values of fault current.

Nuclear energy power plants to be economical may have to be few and large, thus conceivably justifying moving large blocks of energy at high voltage for long distances.

Transmission of 2,000 Mw over 370 miles was estimated by the Germans to cost in capital in the following respective ratios for 400 kv a-c overhead, 650 kv d-c overhead, 220 kv a-c underground and 300 kv d-c underground; 1, 1.28, 4.1, 1.17.

Concrete cooling towers of hyperbolic, natural-draft design cost less than wooden towers only if for water rates of a million gallons per hour or more.

Surface dirt may reduce insulator impulse flashhover voltages and thus disturb the pattern of basic insulation levels.

Capacitor paper can now be made one-fifteenth as thick as newsprint; 5,000 sheets stack up to an even inch.

Boiler fires are being ignited by a jelly-like substance evolved from the thickened fuel developed for flame throwers. Time to reach steam pressure is halved.

Battery negatives connected to station control circuits are less likely to initiate electrolytic action in the coils and joints.

Metal-clad switchgear that affords easy access to instrument transformers wins praise from meter engineers.

FIG 1—FINAL ASSEMBLY AND INSPECTION of Type JWS thermal demand watthour meters before accuracy test entails voltage breakdown test and adjustment of holding-friction of maximum demand pointer with meter elements in series

Thermal Demand Watthour Meters Gang-Tested and Checked

Details of factory procedure which covers all points likely to be involved in routine tests in utility meter shops

W. C. DOWNING, Jr.
Chief Engineer, Lincoln Meter Division
Sangamo Electric Co

FACTORY TESTING of thermal demand meters, as described in this article, includes those operations of calibration and testing performed upon all completely assembled meters to insure that they will measure accurately the demand for which they are designed. The procedure corresponds closely in its scope and requirements to acceptance tests and periodic rechecks of these meters in the meter shops of the utilities, and may, therefore, offer an interesting comparison as to methods and equipment.

Lincoln demand meters come to the test racks where they are to be tested under load, completely assembled, tested for voltage breakdown, and adjusted for demand pointer holding friction. Here they are mounted on the test racks and connected in series for single-phase loading.

Due to the inherent time lag of thermal demand meters, load testing is necessarily time-consuming. Shortcuts which may be helpful in certain types of testing in the laboratory are not, it is felt, suitable for routine factory tests. Economy in testing is attained, rather, through gang testing in groups as large as practicable and through careful scheduling of testing procedure.

Initial Overload

In a normal testing schedule, potential is applied to the watt demand meters and a suitable load established through them shortly before the factory closing hour to insure that the meters are properly connected, that the polarity and magnitude of the load are correct, etc. The load is then adjusted, by means of the manual controls, to 133⅓% full scale load at 0.75 pf and a time switch is arranged

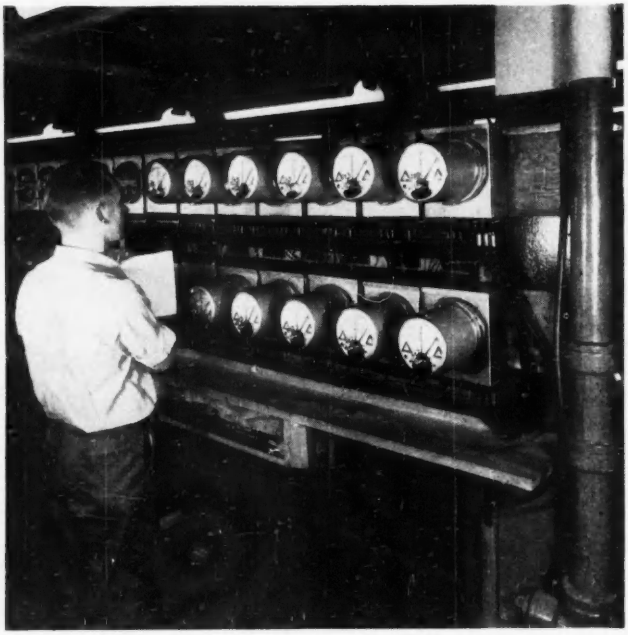


FIG 2—SOCKET bottom-connected for flexibility of connection. The operator is recording balance readings on three-phase four-wire meters

FIG 3—A LOAD CONTROL STATION. One operator can control two loads of any magnitude up to 135 amp simultaneously, either manually or automatically

in the circuit to apply this overload for three periods of approximately 1½ hours each, separated by "off" periods of 1½ hours, during the night. After the third overload, which is concluded about midnight, the current circuit is opened but the meters are left on potential. The purpose of this overload is primarily in the nature of a stabilizing or aging operation, supplementing the regular five-day cyclic heat-treatment of the bimetallic coils which occurs before assembly.

Meter Adjustment

As the meters have been on potential with the current circuit open for some hours when the factory resumes work the morning following the overloads, the pusher pointer may be adjusted to zero at once and the calibration started. With the meter elements connected in series, a single-phase load of proper magnitude is applied to the meter for approximately four demand intervals and the meter adjusted to full load indication. In determining this adjustment, the operator depresses both pointers, then releases them slowly until they come to rest with demand pointer holding back the pusher pointer by the amount of the friction setting. The operation is repeated, while the full load adjustment is gradually changed, until the desired pointer indication is obtained. The maximum demand pointer is then moved out of the way of the pusher pointer which, without the restraint of the demand pointer, should increase its indication by about 2½% of full scale. This difference in readings is directly a check upon the friction adjustment of the demand pointer.

Balance and Scale Tests

Meters are tested for balance, or equality of elements, in accordance with the provisions of the Code for Electricity Meters. Since only a comparison of indications is required, with full load through each element alone and a corresponding load through all elements in series, these readings are taken with the pusher pointer alone in order to save time. In addition to their direct purpose, balance tests are in a qualitative sense indicative of other meter characteristics. Tests at low power factor, for example, which are considered design

or control tests, are not included in routine testing but the same factors which would cause excessive power factor errors tend also to produce balance errors sufficient to cause rejection.

Scale accuracy is checked by applying half load, elements in series, for three demand intervals. As in any test where the actual reading, rather than comparison of readings, is important, the position to which the demand pointer is pushed by the pusher pointer is read. In the case of three-wire meters, where balance readings occur at half scale, the balance reference and the scale check may be combined by recording the demand pointer indication and then the indication of the pusher pointer alone.

At the conclusion of these balance tests and scale check, full load is again established with elements in series. Any meters in which the half-load series reading has not fallen exactly on the half scale point of the dial, but in which the deviation is not sufficient to cause rejection of the meter, are then readjusted to split the error between half and full scale readings.

Check of Connections

Since all of the above tests, whether single-element or with elements in series, are made with all potential circuits energized, they do not constitute a check on possible cross-connections between meter elements. Accordingly, on polyphase meters, load is applied to one element only and the potential disconnected from all other elements. This load needs to be applied for only a few minutes as any positive deflection of the meter indicates a correct connection; the test is required on all except one element in a multi-element meter.

Final Check

With the exception of a few types of meters, such as the two-element, three-phase, four-wire watt-demand meters, the demand totalizing meters, and the kva demand meters, the tests described above may be completed in one working day; but in any event, the meters are left on potential on the test rack the second night. This permits a final check of the zero adjustment on the second morning before the meters are removed from the racks and prepared for shipment.

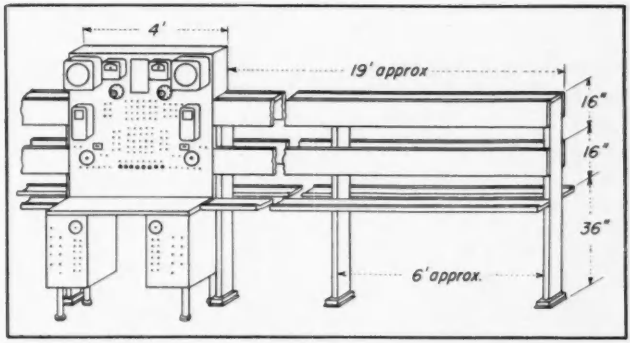


FIG 4—WOODEN RACKS carry two rows of meters on each side. The aisle is five feet wide. Fluorescent lighting is arranged to give shadowless illumination on the meter dials

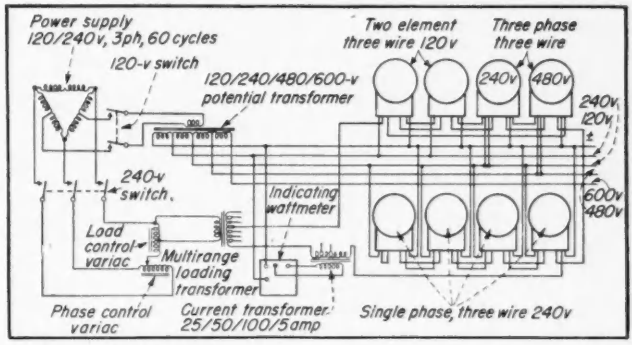


FIG 5—MANUAL load control circuits

The average length of time a demand meter is on the test rack, including the time required for connecting circuits, disconnecting circuits, cleaning covers, reclosing test links, etc, is roughly, two days. It is evident, therefore, that a first requirement for testing facilities is adequate test rack space for several days production of meters and that rack capacity may logically exceed test circuit capacity, since one rack of meters may be under load while meters are being changed on another rack.

The second requirement—of extreme flexibility of both test racks and circuits—follows from the wide variety of types and capacities of demand meters which must be accommodated. These may include ampere demand, watt demand, or kva demand; indicating or recording; socket, bottom-connected, or switchboard mounting; all the various combinations of single-phase and polyphase circuits; for standard voltage ranges; and a number of special current ranges in addition to the standard 5, 15, and 50-amp ratings. Furthermore, while the standard ranges of meters are normally scheduled in quantities suitable for gang testing, there are always the special types, possibly quite few in number, which must be accommodated for test; testing circuits, therefore, must be planned to provide load control not only for 50-amp as well as 5-amp meters but also for one meter as well as 50 meters.

General Arrangement

The basic plan of the present Lincoln meter testing department may be described briefly as consisting of unit test rack sections, 16 in number and each capable of accommodating up to 50 meters, complete, with one loading circuit and outlets for three

voltages; load control stations capable of handling up to eight separate loads simultaneously; and switching and bus facilities to permit the connection of any unit test rack section to any load control station. These units are arranged in four rows, each consisting of two test racks, approximately 19 ft long, separated by a load control station. Each side of each test rack constitutes a unit test rack section and each control station is equipped to control two loads.

Test Racks

Test racks are simply constructed of wood as shown in Fig 4 to carry two horizontal rows of meters on each side, with a shelf directly below the meters to facilitate loading and unloading of the rack. In order to minimize the transmission of mechanical vibration from the factory floor to the test racks, the uprights of the rack are set upon blocks of balsa approximately two inches thick.

Mounting facilities for bottom-connected meters consist only of wood screws set in the rack at intervals of eight inches and all connections are made between meters by flexible leads. On five test rack sections allocated to socket meters requiring four or five post sockets, the sockets are installed on 10-in. centers and all right hand and all left hand circuits permanently connected in series with No. 1/0 solid copper. One test rack section is allotted to meters requiring eight terminal sockets; rectangular sockets are employed but the lower side is removed and a polyphase terminal block permanently wired to the socket terminals making, in effect, a "bottom-connected socket". Such a socket may then be connected by flexible leads to adapt it for the testing of any type or capacity of socket meter, although in normal use it is reserved for four-wire and transformer type three-wire meters which cannot be accommodated by the permanently wired sockets (Fig 2).

Current Circuits

Each test rack section has one loading circuit consisting of a pair of heavy conductors leading from plug receptacles at the adjacent control station to plug receptacles at each end and at the center of the test rack section. In addition, a bare copper bus extends the length of the rack below each row of meters. This arrangement permits considerable flexibility of connection, both as to quantity and type of meters, with a minimum of long, loose conductors, since the bare transfer bus may be tapped at any convenient location close to the last meter in the row. These circuits are of adequate current capacity for testing meters rated up to 100 amp at full scale.

On each test rack section, three-wire potential circuit outlets are provided adjacent to each meter test position, making available two voltages at each test position. These circuits are so sectionalized that each third of a test rack section may be energized from any two of the three voltages available at a small distribution panel located on the test rack; this panel, in turn, is supplied from the adjacent load control station, where any three of the four standard voltages available—120, 240, 480, or 600 v—may be selected.

Potential Circuits

The ratio of the four voltages available at the load control station is held accurately by a transformer of large capacity, so that a 6-kw load held at 120 v at the load control station is a 6-kw load for a 120-v meter, an accurate 12-kw load for a 240-v meter, or an accurate 24-kw load for a 480-v meter. In grouping meters for gang testing, then, it is only necessary that all meters be of the same current rating and of the same general type of base (i.e., either bottom-connected or socket). Thus single-phase, two or three-wire, polyphase, three or four-wire, or multi-element meters, with any of three voltage ratings, may be tested with a single load by proper connections if all are of the same current rating.

All test rack circuits terminate at one of the four load control stations. The load to any test rack may be controlled from the station to which it is connected or it may be connected through by means of heavy buses joining all four stations to be controlled from any other station. Each station provides complete facilities for controlling independently two loads, of any magnitude up to 135 amp, either manually or automatically. The general construction of a load control station is shown in Fig 2 and 4.

The circuits employed in manual load control are shown schematically in Fig 5. For the current circuit, two 240-v, 9-amp variacs are connected across the 240-v delta supply in a modified T-connection, with one variac directly across one 240-v line and the other from the opposite point of the delta to the brush of the first variac. As the brush position of the first variac is changed, the phase, and to some extent the magnitude, of the voltage applied to the second variac is changed. The voltage between the fixed end and the brush of the second variac is applied to the primary of the loading transformer. It is normally unnecessary to adjust the phase-control variac except at the beginning of a test and thereafter only the load-control variac is used to vary the voltage on the loading transformer.

Maintenance of Load

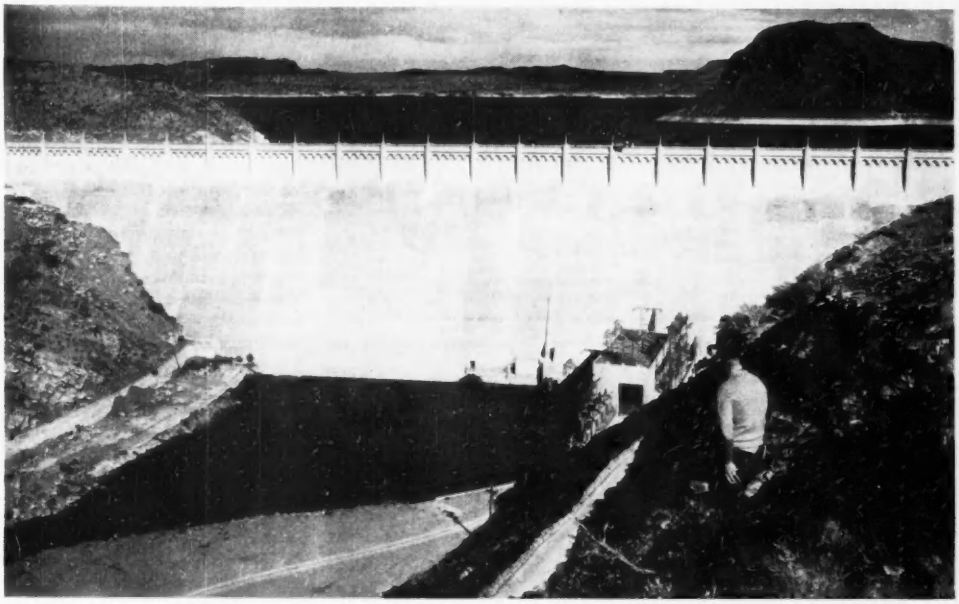
The loading transformer consists of a primary winding for operation up to 240 v and a secondary winding tapped to provide up to 25 v in steps of 2.5 v; and from 25 to 50 v in steps of 5 v. Proper selection of voltage taps, in conjunction with the variation obtainable from the variac supply, makes it possible, with adequate sensitivity of adjustment control, to hold loads up to 135 amp on any number of watt demand meters from one to approximately 50 meters.

For loads through 10 amp, the output of the loading transformer is applied through the current coils of an indicating wattmeter directly to the rack loading circuits, and for currents in excess of 10 amp a current transformer having 25/5, 50/5 and 100/5 amp ranges is cut in between the line and the indicating wattmeter. This wattmeter is of the laboratory portable, ¼% accuracy type and, being periodically checked in the standardizing laboratory, serves as the secondary standard by which the demand meters are calibrated when manual load control is employed.

Automatic Load Control

Manual load holding, originally employed for all Lincoln demand meter testing, has now been superseded by automatic load control* for the most watt demand meter testing.

* Details of the automatic load-holding installation will appear in a subsequent issue.



ELEPHANT BUTTE POWER PLANT changes turbine runners to match major five to ten-year cyclic changes in hydraulic head

Shifting Turbine Runners Improves Hydro Plant Operation

Large variations in hold-over reservoir makes interchangeable high and low-head runners economical. Cavitation problem solved, power output increased, and $29,000 saved annually

A. W. SCHMIDT
Acting Chief
Power Operation and Maintenance Division
Bureau of Reclamation, Washington, D. C.

SEVERE pitting and erosion of turbine parts by cavitation is largely eliminated by changing turbine runners to match the condition of the cyclic reservoir at the Bureau of Reclamation's Elephant Butte Power Plant in New Mexico. Also, plant efficiency is increased approximately 3%, thus supplying additional power in an area that is critically short of power.

The new operating plan, believed to be the first of its kind, calls for the shifting of one of the Francis-type turbine runners at this three-unit plant with each major change in hydraulic head. At this plant, these major changes in hydraulic head occur roughly at five to ten year intervals, due to the large storage capacity of the reservoir and hydrological conditions in general. The plan probably can be used to good advantage at other hydroplants having storage reservoirs of the cyclic or hold-over type and where hydraulic head variations are large.

The power plant was placed in operation in 1940 at Elephant Butte Dam on the Rio Grande River, which for the previous 24 years had been used for storing irrigation water. In 1938, Caballo Dam was built some 25 miles downstream from Elephant Butte. This allowed building a hydroplant at Elephant Butte which could be operated the year around, since Caballo re-regulates the river to fit the irrigation pattern. But the quantity of water that may be used at Elephant Butte power plant during an operating year is limited, except during periods of spillage, to only that water required by the primary water users downstream. This requirement is typical for certain arid

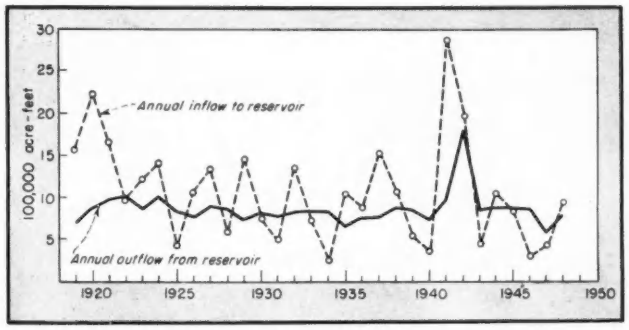


FIG 1—OUTFLOW has been relatively constant because large storage capacity of the reservoir compensates for the large variation of inflow

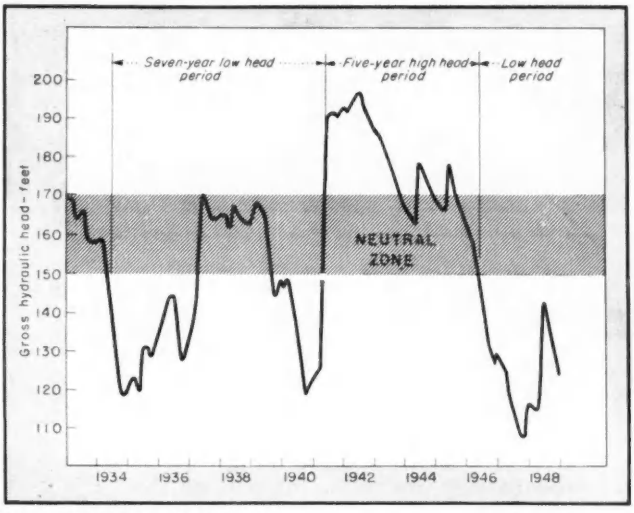


FIG 2—HYDRAULIC HEAD is subject to wide variations because of changes in storage between wet and dry cycles of years

regions of the West, where available water is carefully watched and divided by law.

The plant is conventional, with 3 vertical type units, each rated 9,000 kva at 90% power factor. The Francis-type turbines are rated 11,500 hp at 140-ft head. Because of the large variation of hydraulic head, more design emphasis was placed upon capacity characteristics than is generally done by the industry at large where hydraulic head variations are usually much smaller. This was necessary to ensure sufficient continuous power at low hydraulic heads to make the power readily marketable. Consequently, the turbine design sacrifices overall plant efficiency to gain additional capacity during periods of low storage. This water condition is found at several Reclamation hydroplants located at irrigation storage dams of the hold-over type. As might be expected, cavitation problems at some of these plants are difficult and it was this problem at Elephant Butte that created the new operating plan.

The runoff characteristic of the Rio Grande River is "flashy". It has sharply peaked seasonal variations and also large annual variations. Existing records covering the last 52 years of flow, show that at San Marcial, New Mexico, at the head of Elephant Butte reservoir, the annual discharge has varied from a maximum of 2,895,000 acre-ft to a minimum of 178,000 acre-ft. With this wide variation in annual runoff and the need for a fairly constant available supply for irrigating project lands, a reservoir of unusually large capacity was created at Elephant Butte. This reservoir had an original capacity of 2,638,860 acre-ft or, roughly, two and one half times the annual run-in. As is shown in Fig 1, the large variations in annual runoff have been damped out by the hold-over capabilities of the reservoir. Water releases each year have been fairly constant, regardless of whether it be during years of drought on the watershed or during a period in the wet cycle. But, as shown in Fig 2, there are large variations in hydraulic head due to the changes in storage between wet and dry cycles of years.

In studying the cavitation problem, it was noted that the holdover type reservoir, where the ratio of reservoir capacity to mean annual runoff is high, acted much in the same manner as inertia does in a mechanical system. That is, when the reservoir reached a near full condition, water surface elevations generally stayed high for a number of years. Likewise, when storage becomes seriously depleted, water surface elevations usually remained at the lower levels for a period of years. Fig 2 shows two of these cycles.

Changing Runners Difficult

This phenomenon suggested that the use of supplemental high-head runners might be practicable. But the plant arrangement makes changing runners difficult. Generator shafts are coupled directly to their respective turbine shafts. Turbine runners must be removed from above. Consequently, changing turbine runners requires dismantling the generating unit and then reassembling it. This requirement made it impractical to change turbine runners often. But further study showed that by changing only one turbine runner with each major change in hydraulic head, which occurs roughly at nine-year intervals, the operating units would match hydraulic heads fairly close. Furthermore, this change of runners could be used to good advantage in repairing cavitation damage. In other words, this three-unit plant could be operated essentially as though designed for operation at two dif-

ferent hydraulic heads, thus gaining the efficiency and capacity inherent therewith.

The present operating plan operates two original lower-head runners during periods of low reservoir storage. The third unit, with a higher-head runner, is operated during the daily peak. When the reservoir storage rises above a predetermined level, the turbine runner in one machine is changed from original runner to higher-head runner. In these periods of high reservoir storage, the two machines having high-head runners are used. The third machine, with an original runner, is generally held in reserve. At these higher hydraulic heads, usually two machines have sufficient capacity to supply the required plant output.

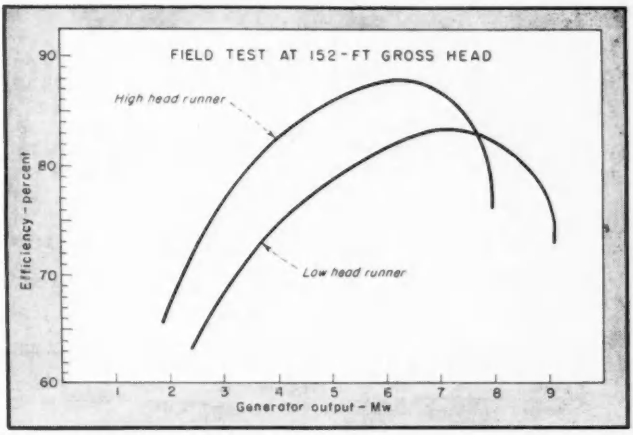


FIG 3—EFFICIENCY COMPARISON of high and low-head runners at 152 ft gross head

Based on Past Experience

The zones for high-head operation and low-head operation were chosen more or less arbitrarily on the basis of the 28 years of past experience at the reservoir. A neutral zone was set up to eliminate those runner changes which, in the view of later water condition, might prove to have been undesirable and also to elminate seasonal effects. The limits established are shown in the graph of hydraulic heads, Fig 2. A gross hydraulic head of 170 ft was chosen as the point for changing to high-head runner, 150 ft to low-head runner, and the area between as neutral zone. The two cycles shown are quite representative, although seasonal effects are not as prominent as those which have occurred in general. The seven-year period from 1934 to 1941 was a period of low water. During periods such as this, two low-head runners are used. The five-year period from 1941 to 1946 is a period of high water and during these periods two high-head runners are used. Boundaries of these predetermined zones are not viewed as sharp lines that order changes in a turbine runner, but rather as indicating the probable need for such change. When the water surface gets near a critical point in the neutral zone where the question presents itself as to whether a change of runners should be made or not, the condition is viewed in the light of such factors as the season of year and the predictions of inflow by snow survey. For example, assume that following a long wet cycle and upon entering into what may be a dry period, the changeover point of 150 ft gross head is reached in April. At that time, inflow forecasts are available based upon snow surveys of the water shed and decision in this matter would be made on the basis of the forecast.

The first high-head runner for Elephant Butte was ordered in 1945 and placed in service in April 1946. Since that date a number of comparative field tests have been made at 152-ft gross head and below. Performance of the new runner has been above the level anticipated and these tests have proven the desirability of continuing the plan by purchasing and installing the second high-head runner when the present cycle of low reservoir storage has ended. The comparative efficiencies obtained by use of the two runners at 152-ft gross head, is shown in Fig 3. These efficiencies are overall efficiencies based upon the theoretical potential energy existing in the water at the measured gross head and the electric energy obtained therefrom. The difference in generator output is shown and also the difference in shaping of the efficiency curves. Part of the difference in efficiency between the two runners, probably in the neighborhood of $\frac{1}{2}\%$, is due to greater seal-ring leakage in the case of the original low head runner. Other conditions of the runners and machines were quite comparable.

The increase in energy output and the financial gain which is obtained from using runners more nearly matching hydraulic conditions is considerable. Studies made, based upon hydraulic conditions at the dam during the period 1919 to 1945 and tests of machine performance, show that for this period approximately $7\frac{1}{2}$ million kwhr per year of additional energy would be generated under the new plan of operation above that produced by the original runners. This additional energy has a value on a 4 mill per kwhr basis of approximately $30,000 per year. Deductible from this increased revenue are expenses connected with the runner change and that charge represented by the increased plant investment due to supplemental runners. Reservoir cycles have averaged about nine years in length, thus requiring on the average one runner change each nine years. The cost of this work when divided and placed on an annual basis is approximately $300 per year. The annual charge due to increased plant investment amounts to approximately $750, on the basis of straight-line depreciation during a 35-year life and 3% interest annually on that portion unrecovered by depreciation.

This gives a clear profit of approximately $29,000 per year over that obtained by the former method of operation. Consideration is now being given to the advisability of using this operating plan at those other Bureau plants having holdover-type reservoirs.

Light Steel Tower Design May Save One-Tenth Over Wood Pole Lines

Reduction of longitudinal pull requirement from 12,000 lb to 3,000 lb in accessible areas justified by 7,000 mile-years of 230-kv experience

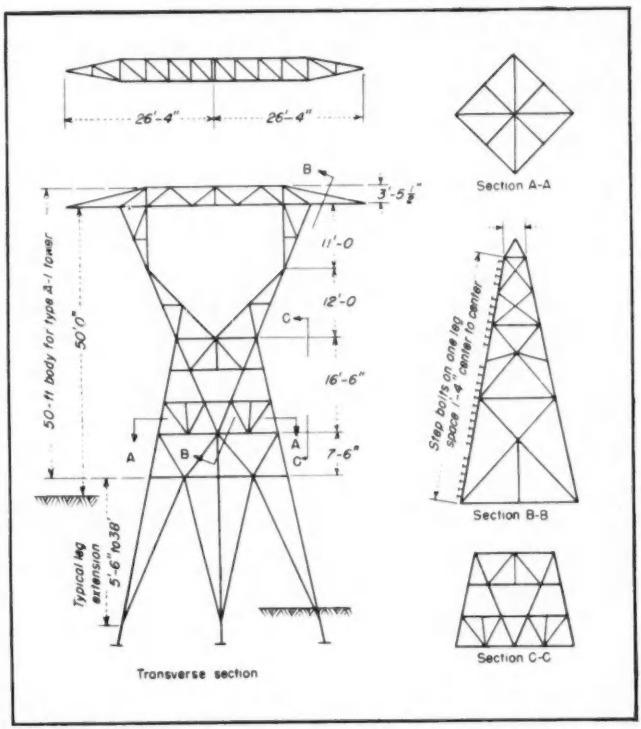
F. W. FARR
Chief, Structural and Mechanical Unit
Transmission Section
Bonneville Power Administration
Portland, Ore

RISING COSTS OF LABOR and material have prompted the Bonneville Power Administration to examine more closely the basis for design of its 230-kv steel tower lines. The result is design of a light steel tower to be used instead of wood pole construction on many 230-kv Bonneville lines.

Wartime shortage of steel gave impetous to construction of wood pole 230-kv lines. Design conditions for these lines, of course, could not be as severe as for steel tower lines. Until the new design, 230-kv steel towers were designed for full longitudinal pull of one broken conductor in addition to transverse loads. This amounted to an unbalanced pull of 12,000 lb and transverse loads based on ½ in. of ice and 8 lb wind, plus wind load on the tower itself. Wood pole lines were designed primarily for transverse loads only.

Economy studies made during the war showed first cost to be lower for 230-kv wood pole lines than for 230-kv steel tower lines. Annual costs were also lower, compared with annual costs for the conventional steel tower designed for the above-mentioned conditions. Since it seemed improper to compare the two types of construction on this basis, a light steel tower was subsequently developed. It was designed for the usual transverse loads but for a longitudinal load of only 3,000 lb.

These conditions are more nearly comparable to those governing design of wood poles for high voltage lines.



TEN PERCENT lower annual cost compared to 230-kv wood pole construction is expected of this light steel tower. It was designed by B P A for areas not subject to severe icing

They are considered acceptable under many conditions in the light of BPA experience with heavy transmission line conductors. This experience indicates that broken wire conditions for which standard towers have been designed occur infrequently. As a matter of record, the Administration has not had a broken conductor due to ice load on any 230-kv line since the Federal system was put in operation. This experience includes over 7,000 mile-years of 230-kv operation.

Economy studies in 1947 based on this light steel tower showed its annual cost to be approximately 24% less than 230-kv wood pole construction. These studies were based on comparable lines through fairly level desert areas with good access for construction and maintenance. Wood structures were assumed to have a

TABLE I—Comparative Estimated Costs For Light Steel vs Wood Pole Construction

Type Construction	Initial Cost—%	Annual Costs*—%
Light steel towers	100	90
Wood poles, spar arms	81	100

*Annual costs on actual structures, including interest on investment, amortization, operating and maintenance on structures. Does not include cost of surveying, right of way or other non-structural costs common to both types of lines.

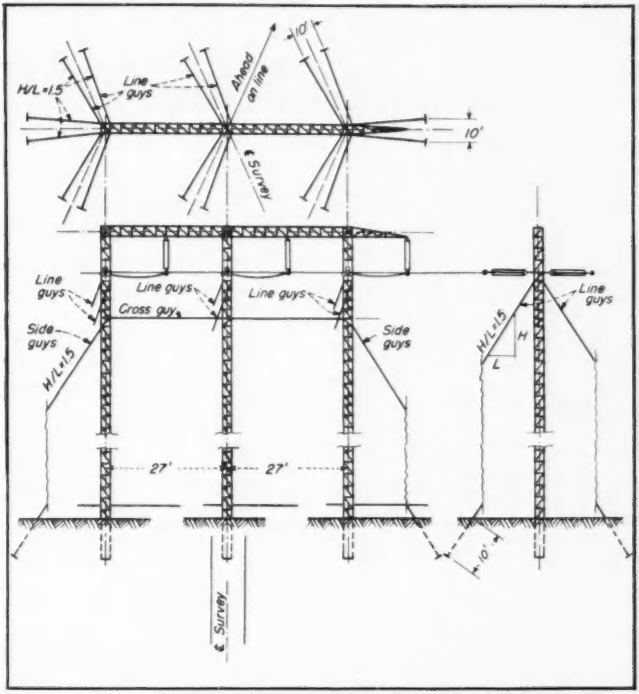
twenty-five year life, steel structures a fifty year life. Annual costs include interest on investment, amortization, operating and maintenance on the actual structures. They do not include cost of surveying, right-of-way or other non-structural costs common to both types of line.

Since the 1947 studies, pole costs have increased approximately 30% steel costs 70%. Annual costs, however, still favor light steel construction by about ten % (see Table I). As a result, the Administration has decided to build most of its 230-kv lines with steel towers, using the light towers wherever possible.

Another important saving has resulted from redesign of dead-end structures and angle type structures. Self-supporting structures will no longer be used for line angles and dead end points. Instead, an entirely new series of designs using guyed lattice-pole structures will be used. The guyed, lattice-pole, dead-end structures weigh about 16,500 lb compared to 32,000 for a self-supporting single-circuit, dead-end structure. Similar savings are realized on guyed angle structures and transposition structures. In addition to the substantial saving in steel, erection labor is reduced by approximately 15%.

There are mountainous areas in Washington, Oregon and the Columbia River Gorge where conductor and structure are subject to severe ice conditions. In addition, parts of these areas are accessible in winter only to men on snow shoes. Because of the importance of avoiding prolonged outages, the original steel tower designed for broken conductor conditions will be used exclusively in these areas. Also, where more than one line is planned through heavily timbered country, it is usually more economical to use double circuit steel construction. The high cost of clearing right-of-way is a considerable factor in selecting type of construction for such areas.

The light steel towers will be used in areas having relatively good access at all times of the year, and in terrain ranging from flat and rolling to moderately rough. Orders have been placed for towers to add more than 100 miles of line in such areas.



GUYED LATTICE pole structure for dead-end and angle points. Approximate weights are 16,500 lb compared to 32,000 lb for self-supporting single circuit dead-end structure

Survey Lines at Night Using Signal Lamps

A NIGHT TIME surveying technique involving the use of spotlights and high power signal lights has been worked out by survey teams of the West Penn Power Co where lines traverse rugged and densely wooded territory.

Often in such terrain it was found impossible for the transitman, in the middle of a heavy forest, to see the rodman three or four miles away in a location which was just as heavily wooded.

The situation was met by the West Penn teams where there was a possibility of a direct line of sight by going out at night with spot and war surplus marine signal lights. The rodman turned a spotlight directly toward the transitman who sighted on the pinpoint of light seen through the trees.

If a hill or mountain intervenes, the signal light is turned straight up into the sky and the transitman sights on the thin pencil of light. In this way sights as long as five miles have been taken on a pitch black night when there was rain or mist to intensify the light beam. The practice was reported in the West Penn News.

New Devices Aid OCB Testing

Mechanical direct-indicating type pressure cartridges, current transient recorder supplement conventional instrumentation in field tests of heavy duty oil circuit breakers

D. M. UMPHREY
Chief Engineer
V. A. TREAT
Manager
Engineering Laboratory
Pacific Electric Manufacturing Corp
San Francisco, Calif.

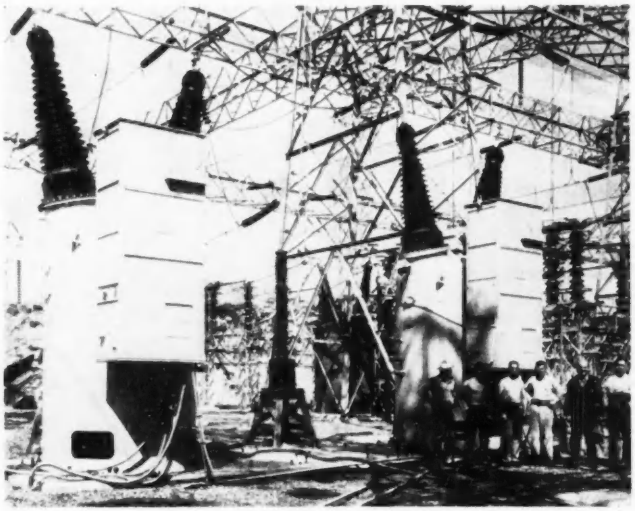
FIELD TESTING of oil circuit breakers for maximum interrupting capacity has become much more complex with rapid growth of system capacities. New techniques and devices for control and instrumentation are constantly being developed to provide reliable records of predetermined, repeatable tests. The need for such devices is accentuated by the extreme difficulty of rescheduling tests in the event of failure of auxiliary equipment.

For recent short circuit tests of a 220-kv circuit breakers conducted in cooperation with engineers of the U. S. Bureau of Reclamation, Pacific Electric Manufacturing Corp for the first time used pressure measuring cartridges and a current transient recorder to supplement conventional instruments. Meticulous instrumentation and control were required to realize maximum benefit from the tests. Controls provided for closing the fault initiating breaker at any point on the voltage wave and causing the clearing breaker to separate contacts at any desired instant. Symmetrical or offset values of short circuit current were thereby obtained as desired, within very narrow limits. Maximum equivalent three phase kva interrupted reached 9,620,000 kva, believed to be the heaviest fault thus far initiated and successfully cleared.

General behavior of interrupting devices in an oil circuit breaker can be closely followed by observing pressures developed within them. Futher clues to performance are provided by measuring tank pressures, which are easily obtained. Measurement of pressures inside each interrupting device is important, since it indicates accurately its adequacy as short circuit values are increased. Reliable measurement of pressures within the tank of a breaker energized at 220 kv, however, is not a simple problem. Others have recorded interruptor pressures during short circuit on the grounded side of the breaker.

Small pressure measuring cartridges of the mechanical, direct indicating type provided an excellent solution for the problem. Cartridges were screwed into sockets located on each of the six interruptors inside each breaker. Special valves and fittings were installed on the sides of the tanks to permit passing a special wrench into and out of the breaker without loss of oil. After each short circuit test the cartridges were removed and and pressures recorded. They were then replaced in their sockets for the next test, without any disturbance of oil in the breaker tank. Tank pressures were measured by the same type cartridges, accessible directly from the outside.

These cartridges gave excellent records of peak pressures, and provided data for any desired location inside the breaker, either on the hot or grounded side. These data indi-



USBR Photos

OIL CIRCUIT BREAKERS tested by Pacific Electric Manufacturing Corp in cooperation with U. S. Bureau of Reclamation have special valves on tank for removing peak pressure measuring cartridges without disturbing oil

cated that only nominal pressures were developed within the interruptors, factor of safety in the design being something more than 10 to 1.

The problem of recording transient pressures is not solved, however, by the peak pressure cartridges. It was decided to carry on during the tests development work on two experimental approaches to this more difficult problem. Both methods are electronic; both are still in the development stage.

The first method, using a variable condenser in a capacitance bridge circuit, is not new. A diaphragm subjected to the pressure to be measured forms one plate of a condenser. As the diaphragm moves under variations in pressure, capacitance of the condenser changes. Unbalance of the bridge circuit is then a function of pressure. Disadvantages of this system are the difficulty in maintaining output from the bridge directly proportional to pressure, and the problem of insulating the device from the 220-kv circuit.

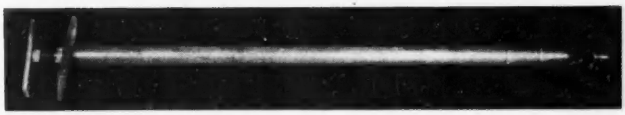
The second experimental transient pressure recorder eliminated the insulation problem. It consists of a miniature frequency-modulated transmitting station complete with self-contained power supply, located inside the breaker at the point of pressure measurement. This midget transmitter has its output frequency modulated by a variable condenser. The variable condenser consists of a pressure measuring diaphragm as one plate and a fixed metal disc as the other. A small f-m receiver located opposite a window in the bottom of the tank picks up the modulated signal from the transmitter after which it is suitably amplified for recording purposes. Neither of these experimental pressure recorders was depended on for statistical data. Both require further work to establish their usefulness for this application.

Current Transient Recorder

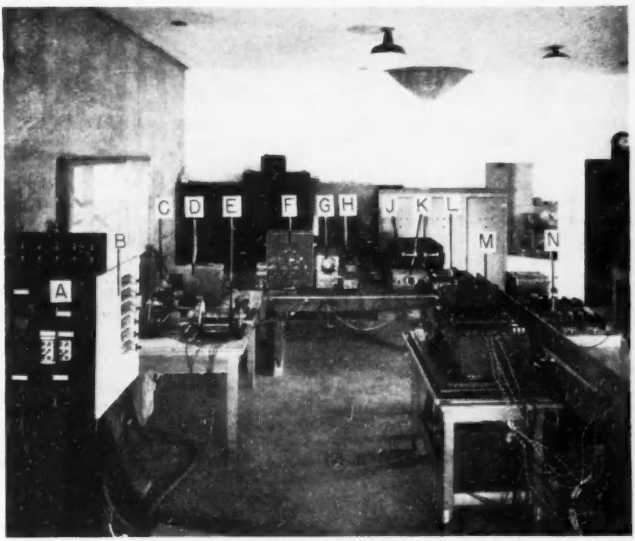
A twelve element laboratory oscillograph was used to make photographic records of the tests. Standard procedure in circuit breaker testing is to wait for development of the oscillographic film of the shot just interrupted before proceeding with switching operations for the next higher test. This procedure was followed for the permanent records of the test results. In addition, however, a current transient recorder flashed approximate results of the test just completed on an oscilloscope within a fraction of a second after the short circuit was cleared. Preliminary conclusions could be reached on the success of each test long before the oscillograph film was available.

The current transient recorder is basically similar to a home type wire recorder consisting of motor-driven wire or tape reels, recording, playback and erasing heads. The significant difference is that the wire is a short loop, the entire length of which passes under the heads approximately five times a second. The transient to be recorded (not over 12 cycles in duration) is fed to the recording head. The playback head repeatedly sends this message to a slow sweep oscilloscope. The sweep frequency is controlled by the transient recorder so the transient reappears in the same location of the oscilloscope screen five times a second. Even at this low frequency of repetition the visual indication on the screen of the oscilloscope is quite satisfactory.

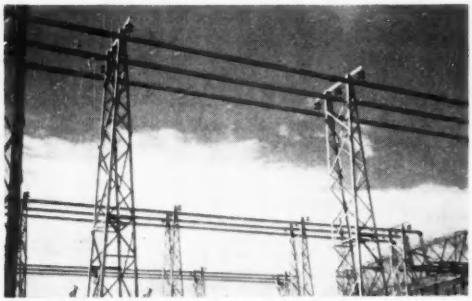
Tests of this magnitude justify the use of such additional equipment to obtain more than the conventional data of current interrupted, bus voltage and rate of recovery voltage. Added information obtained by such supplementary equipment may contribute materially to analysis and evaluation of test results.



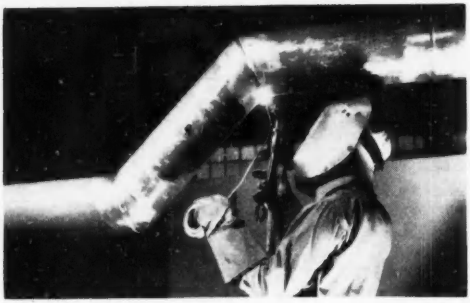
PRESSURE MEASURING CARTRIDGE and special wrench used for removing it after each short circuit test. Cartridges measure peak pressure inside the breakers' interruptors and permit measurements to be made on either hot or grounded side



CONTROL ROOM INSTRUMENTATION for oil circuit breaker testing includes a wire recorder (F) and oscilloscope (G) for immediate check on test results. Current transient is recorded on a continuous loop of wire in the recorder, which feeds it immediately into a five per second sweep on the oscilloscope. Other instruments and controls are: (A) main control panel (B) test ocb selector switches; (C) synchronous closing control; (D) cathode-ray oscilloscope for synchronous closing control; (E) cam-type timing switch; (H) pressure-record amplifier; (J) cathode-ray oscillograph; (K) calibrating oscillator for cathode-ray oscillograph; (L) tripping transformer for cathode-ray oscillograph; (M) 12-element magnetic oscillograph; (N) d-c linear voltage amplifiers



TWO 5-IN. ALUMINUM CHANNELS on conventional suspension insulators provide a "swinging" bus for 13.8-kv service



INERT GAS ARC WELDING of 8-in. over-all diameter by 0.450-in. wall aluminum tubular bus is done in overhead position

Aluminum Characteristics For Bus Application

Comparative factors of voltage drop, weight, thermal behavior, short circuit stresses, skin effect and weldability affecting selection and use

L. T. GUESS
Aluminum Company of America
Pittsburgh

IF the voltage drop is the controlling factor, the cross-sectional area for aluminum bus will bear the same relation to the area of copper bus as the inverse ratio of the conductivities of the two. For average commercial bus bar the ratio is $\frac{99.00}{60.97}$ or 1.62. Because of the difference in density of the two metals, however, the aluminum conductor will weigh only 48.4% as much as the copper conductor.

Voltage drop (IZ) is usually not the controlling factor for bus conductor selection in the utility industry where relatively high voltages are the rule. For heavy industry, however, voltage drop frequently is the controlling factor because of the lower voltages used (normally 440 v).

Industrial concerns are continually faced with the difficult problem of meeting voltage drop limitations in laying out their electric systems. While the conventional methods of bus distribution, making use of multiple cables, flat bars, channels, angles or tubular conductors, all have their particular advantages, they are limited, chiefly because of excessive voltage drop or high installation cost.

Low Reactance Design

Since aluminum can be extruded in practically any shape, a new field is opened to the designer for arrangement of the conductor. Using these developments, a new type of bus known as Sector Bus has been designed for alternating current loads of from 2,000 to 5,000 amp at voltages up to 600 v. The extruded sectors for the three-phase bus are spaced 120 deg with phase separation of one inch. The distribution of the phase currents and the close spacing give a high capacity bus with very low IZ voltage drop.

Temperature rise of the conductor is usually the controlling factor in bus design, and the rise is normally limited to 30 C. This protects the electrical equipment to which it is attached from excessive heat transfer, and helps prevent the joint deterioration which may occur at elevated temperatures.

Temperature Rise

As for temperature rise, the I^2R loss per unit of surface area must be the same in the aluminum bar as in the copper bar for equal temperature rise. This condition results if the cross-sectional area of the aluminum bar is made 27% greater than the copper bar by increasing the width of the aluminum bar, but not its thickness. If an increase in width of a single bar becomes impracticable, the number of bars per conductor should be increased. Sometimes it is necessary to increase cross-sectional area by means of greater thickness only. In this case, the thickness must be increased approximately 50% over that for copper bar to give the same theoretical heat loss per unit of surface area.

Heavy currents are common in the

Excerpt from paper at recent meeting of the EEI Electrical Equipment Committee.

* See "Aluminum Conductors Used Exclusively Throughout New Rolling Mill", Electrical World, April 24, 1948, p 83.

electrochemical industry. Here the cost of power may well be the most important consideration in conductor selection. The ratio for economical cross-section based on equality of values for losses and fixed charges on conductor investment is

$$\frac{A_{Al}}{A_{Cu}} = \frac{1360\sqrt{\frac{1}{P_{Al}}}}{590\sqrt{\frac{1}{P_{Cu}}}}$$

Bus Design

The design of a bus, especially an enclosed bus, is not always simple. Some of the problems the designer must consider are short circuit forces, skin-effect, and weight on supporting structures.

Electromagnetic forces between buses at rated bus currents are normally very low. Obviously great strength in design is not required. With the integrated power systems of today, however, short circuit forces in the order of tons per foot are possible with normal bus spacings. The increase in cross-sectional area for aluminum inherently means a higher section modulus, especially for tubular and structural shape conductors. This increase in section works in favor in aluminum when calculating short circuit forces, and helps to compensate for the lower tensile properties of aluminum.

Bus Bracing

How to support bus conductors where heavy short circuit forces are possible is a difficult problem. One solution is to employ the so-called "swinging bus" design in which the bus conductors are suspended on conventional insulators so as to allow the buses to swing freely under short circuit conditions. This type of construction has been used by ALCOA engineers for many years.

During World War II, when ALCOA was building substations for heavy loads with possible high short circuit currents, a design utilizing two 5-in. aluminum channel conductors, suspended on ball and socket insulators at 24-ft. intervals, was used for the 13-kv buses. This design replaced an earlier conventional design using high-strength post insulators at 8-ft intervals. Since some of the buses were several hundred feet long, this design resulted in savings in steel and insulators at a time when conservation of critical materials was necessary.

Several plants using this design have experienced short circuits or grounds or have had surges from lightning or switching operations. One plant reported a short circuit across a disconnect switch which was estimated to have carried between 500,000 and 600,000 kva. No one observed the action of the buses at this time, however. Nevertheless, no faults occurred on these buses from forces which presumably were set up by these high currents, and no ill effects could be found.

Skin Effect and Weight

Lower conductivity of aluminum also works in its favor when considering alternating current. For conductors of the same relative size and shape, the skin effect is a little lower for aluminum than for copper since it depends upon resistance as well as conductor shape and size.

The weight of bus conductors on supports is not normally much of a problem. For heavy current buses such as are used in the electrochemical industry, however, the weight of buses on supports must be given consideration along with possible short circuit forces. Here again aluminum is advantageous.

Mechanical rather than electrical considerations are usually more important for outdoor, high voltage substation bus since it is desirable to keep the deflections as small as possible. In the formula for calculating deflections, weight appears in the numerator and modulus of elasticity in the denominator. The ratio of weight for copper and aluminum is 3.29. The ratio of the modulus of copper and aluminum is 1.6. Therefore, the deflection for a bare copper conductor is $\frac{3.29}{1.6}$, or 2.05 times greater than deflection for aluminum conductor of the same size and for the same span.

Bus Connections

Connections in aluminum bus conductors are normally made by bolting or welding. Tests indicate that the overlap practice for flat bar should be about the same for aluminum as for copper. Experiments with varying pressures on aluminum bus bar joints indicate 400 lb per sq in. as a desirable minimum, while values up to 800 lb per sq in. produce some added efficiency for normal contact areas. The use of Belleville spring washers is desirable since pressures are better distributed and maintained with temperature variation than where ordinary flat washers are used. It is well known that the so-called average pressure (in pounds per square inch) is in reality concentrated in a few small points of intimate contact area, and that at these points it is of a high order of magnitude.

Considerable experimental work together with practical experience has demonstrated that best results are obtained when contact surfaces are coated with a joint compound. The use of No-Ox-Id, Grade A Special, in conjunction with abrading the surface through the compound coating, has been used successfully for many years. Developed recently was ALCOA Electrical Joint Compound, which does a better job of breaking down the thin oxide film without abrading. This compound is still considered semi-experimental, but test results look promising.

Welded Construction

Welded construction, being economical and electrically efficient, is perhaps the most satisfactory way of making connections where the job is large enough to justify a welder. All bolted joints, whether of copper or aluminum, deteriorate somewhat with age. With welded construction, joints can readily be made having a conductivity permanently equal to that of the conductor.

Welded installations of aluminum conductors have been in service for many years. These older jobs were installed with either metallic-arc or torch methods, using flux coated welding rod. The development of inert arc welding, which is superior to the older methods and does not require a flux, has given added impetus to welded construction. The largest high voltage bus installation of aluminum conductors to date, using inert arc welding, is the modern substation erected by the Public Service Electric & Gas Company of New Jersey at Sewaren.

Coordination of Distribution Protection

III—Applying Automatic Circuit Reclosers

An examination of the techniques and pitfalls involved in the use of automatic circuit reclosers on distribution circuits . . . Also considerations in protection of primary capacitors and aerial cable

CHASE HUTCHINSON
Electrical Engineer
Ebasco Services Inc
New York

WHEN TWO OR MORE protective devices are cascaded the same fault current flows through all of them and selective action depends on: (1) A difference in tripping time or (2) the fault appearing differently to the different devices. In the second case current setting or pick-up current is the commonly used element. When both a difference in time setting and current setting can be used, it is often possible to operate several overcurrent devices in cascade.

However, when only one of the characteristics is used, the problem of obtaining selectivity becomes much more difficult. If, for example, an attempt is made to operate several devices in cascade that are tripped by instantaneous relays, it is found that operation of a given relay depends upon its current setting (or ohms at a given voltage) and the impedance through the fault. Thus, depending upon fault location, more than one of the instantaneous relays may operate to interrupt line sections unnecessarily.

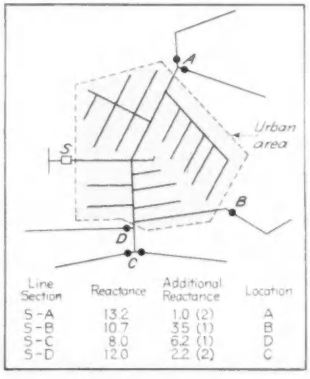
This difficulty commonly occurs when using the selective fuse-breaker scheme to serve both urban and rural loads. In attempting to isolate rural faults from urban sections of the circuit, automatic circuit reclosers are often used. While this may isolate prolonged faults, an unnecessarily large number of momentary interruptions to urban circuit sections may occur due to overlapping protection by instantaneous devices. Alternatively, the instantaneous substation relay may be slowed down to permit automatic reclosers to open first. Then, however, the advantages of rapid opening—reduced wire burn down and damage—are lost in the urban area. Sometimes, this difficulty can be minimized by choosing a substation instantaneous relay current setting less than ground fault current at the recloser location. If several reclosers are involved locate them as corresponding impedance points. Such a scheme lacks flexibility and is poorly adapted to many combination circuits. It may also require the location of automatic circuit reclosers in inconvenient places. To the author's knowledge, there has been no generally satisfactory solution to this problem of obtaining selectivity.

There are at least two general schemes which might solve the problem:

1. A blocking scheme—ie, when fault current flows through an ACR (Automatic Circuit Recloser) arrange for a control signal to be transmitted to substation breaker to stop tripping.

2. Use an instantaneous ohm element of a conventional reactance ground relay at the substation circuit breaker to measure reactance through fault.

Contacts of the reactance relay would be in series with instantaneous overcurrent relay so that tripping



Line Section	Reactance	Additional Reactance	Location
S-A	13.2	1.0 (2)	A
S-B	10.7	3.5 (1)	B
S-C	8.0	6.2 (1)	D
S-D	12.0	2.2 (2)	C

FIG 1—APPLICATION PROBLEM involving use of reactance-ground type relay on distribution circuit

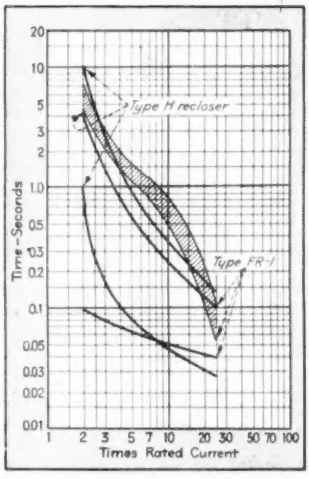


FIG 2—TIME-CURRENT characteristics of typical oil circuit reclosers are approximation of fuse characteristics over useful range

could occur only when reactance is less than some predetermined figure and enough current is flowing to actuate the instantaneous overcurrent relay. The reactance relay would be set to trip for all faults having reactance greater than, say, 110% of the reactance to the (electrically) most distant automatic circuit recloser that has no ACR between it and the substation circuit breaker. (See Fig 1.) At each ACR electrically adjacent to the substation circuit breaker, install reactors of a size such that the total reactance through the reacter is equal to or greater than 110% of reactance to the electrically most distant ACR not having any ACRs between it and substation breaker.

Automatic Circuit Reclosers

Today, ACRs are self-contained interrupting devices in which power for both opening and closing operations is derived from fault current, by storing the required energy mechanically. They are usually single-pole devices with interrupting rating a fixed multiple of continuous operating rating and of minimum pick-up current rating. At least one manufacturer offers a three-pole version which functions as three single-pole devices until the lock out operation which opens all three poles. ACR ratings for standard and heavy duty types are given in Table I.

Chief application of heavy duty reclosers has been in urban areas where load densities and interrupting duties are high. They should be applicable in situations where general distribution is tapped off a high capacity line.

Early ACRs provided for several reclosures (usually three) before lockout. Tripping time was substantially the same for each tripout. More recently some ACRs have two initial openings occuring in a very short time with the subsequent two openings requiring tripping times 25 to 50 times as long as the initial openings. Such a sequence is well adapted to use of single-shot fuses on laterals.

Time current characteristics of ACRs represent an attempt to approach a slope of 2 when plotted on log-log paper, ie. Time $= f(I^2)$. These ACR characteristics are only very rough approximations of fuse performance over the useful time-current range. This is because automatic circuit reclosers must have simple sturdy mechanisms that can be produced inexpensively. Time-current characteristics of two makes are shown in Fig 2.

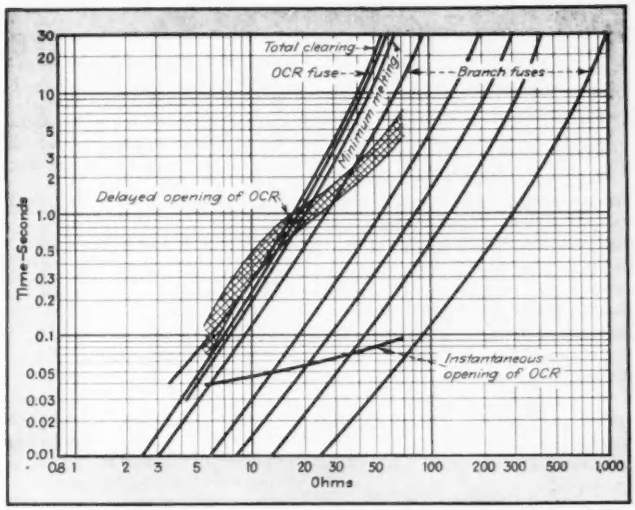


FIG 3—LOCKED CLOSED sequence for automatic circuit recloser provides instantaneous tripping and reclosure of OCR which then locks closed. Heavy fuse and line side of OCR holds in while branch circuit fuses beyond OCR are blowing

A recent development in reclosing sequences provides for the usual instantaneous tripping and instantaneous reclosers, but then instead of delayed tripping the ACR locks closed. A fuse on the supply side of the ACR is of such size that it will not blow while branch fuses beyond the ACR are blowing. Advantage of this arrangement is that, in effect, the delay opening (the fuse on supply side of ACR) has time-current characteristics which parallel the branch fuses. This allows the use of more branch fuse sizes. It also simplifies the coordination job. Fig 3 illustrates the time-current picture of the locked closed sequence. For comparison the delay opening curve of this recloser is also shown. The principle of the locked-closed sequence promises improved service and warrants trial use.

ACRs are usually installed on poles. Maintenance and repairs are handled by removing the automatic circuit recloser to a shop where complete inspection can be economically carried out. Interval between such inspections depends upon local conditions; however a conservative indication of need for inspection may be derived from "Standard Operating Duty" as used on proposed AIEE standards for ACRs for a-c Distribution Systems. This "Standard Operating Duty" is as follows:

Amperes in Percent of Interrupting Rating	Unit Operations
10-20%	40
40-60%	40
90-100%	20
Total Unit Operations	100

TABLE I—Automatic Circuit Recloser Ratings

STANDARD RATING

Voltage Rating Kv	Continuous Current Rating Amp	Interrupting Rating Amp	Minimum Pick Up Current Amp
2.4 to 15	5	125	10
	10	250	20
	15	375	30
	25	600	50
	35	875	70
	50	1200	100

HEAVY DUTY RATING
(Used by one manufacturer)

Voltage Rating Kv	Continuous Current Rating Amp	Interrupting Rating Amp
6.9 to 8.32	60	1500
	100	2500
	160	4000
	200	4000
	250	4000
12.0 to 14.4	60	1500
	100	2000
	160	2000
	200	2000
	250	2000

A unit operation is defined as an opening operation followed by a closing operation.

Protection of Primary Capacitors

Protection needed for capacitor banks varies depending upon capacitor connections. The commonly used connection and the one least susceptible to troublesome effects is the wye connection having the neutral solidly grounded. Because most pole-type distribution capacitors are operated in this manner other connections will not be considered herein.

Protection of capacitors or static condensers usually included surge voltage and overcurrent protection; however many capacitors have been successfully applied where protection has been limited to means for disconnecting failed units or banks. Fuses are effectively used for this latter purpose up to about 75-amp rating. Larger fuses are considered undesirable because of the likelihood of explosive rupture of a unit tank when dielectric breakdown occurs. However, the good reliability of capacitors does not economically support this argument and many banks having larger fuses or the equivalent thereof are giving good results.

Contrary to the recommendations of most capacitor manufacturers, experience with pole mounted 15-kvar capacitor units indicates use of lightning arresters not economically justified even in areas having frequent and severe lightning storms. Capacitors are inherently self-protecting, for the greater the rate of rise of surge voltage the lower the impedance of the capacitor. Experience with capacitors indicates that lightning surges which occur in distribution lines will seldom harm the capacitor unit although in extreme cases flash-over of capacitor bushing may occur. Table II represents composite experience of 10 companies in 7 states during the 5 year period 1937-41 inclusive. About 36,000 kvar of capacitors were involved. Substantially all of these capacitors were wye connected with neutral solidly grounded or the equivalent so far as surges were concerned. About one-half of the capacitors were protected by lightning arresters with remainder having no lightning protection. There was no noticeable difference in failures to support the added investment of lightning protection.

TABLE II—Record of Capacitor Performance

Year	1937	1938	1939	1940	1941	Average
Total No. Units Installed	1,615	1,855	2,186	1,931	2,435	2,004
Cause of Failure						
Defective	6	1	0	2	1	2
Lightning	4	3	6	13	2	6
Harmonics	0	0	0	0	0	0
Unknown	4	2	4	6	10	5
Total Failures	14	6	10	21	13	13
% Failures	0.9	0.3	0.5	1.1	0.5	0.65

Recently H. A. Stites, before the EEI Transmission and Distribution Committee meeting in Swampscott, Mass., gave data on 900,000 kvar of capacitors which indicated a failure rate in the order of 0.35% per year with 83% of capacitors protected by arresters. Failure rates with and without lightning protection were not given.

Aerial Cable Protection

Over-current protection of primary aerial cable is subject to the same factors as open wire, except that for a given voltage drop the lower reactance of cable, resulting from close spacing of conductors, permits longer runs. Aerial cable frequently requires attention to conductor temperature under minimum fault conditions, for excessive time to clear fault or failure to clear fault may cause extensive damage to cable insulation. Elements of this kind of problem were discussed under *Transformers* and will not again be discussed here.

Because the mechanical problem of supporting aerial cable becomes increasingly burdensome as the weight of the cable increases, most aerial cables are made with extruded insulations without lead covering rather than paper and lead covering. Recent developments in insulating materials have favored this practice. Even with the best of these materials, the margin between the impulse strength of an aerial cable and its open wire counterpart is very great. It follows that aerial cables require adequate and effective lightning protection at points where it connects to open wire lines.

Aerial cable used for secondaries and services normally needs no lightning protection. Over-current protection as just discussed is needed if occasional damage is to be avoided. In this connection, it should be pointed out that the likelihood of low current secondary faults may be quite small for systems using aerial cable secondary and service cables *provided:* (1) Such cables are of good quality, (2) are carefully and painstakingly installed, and (3) are kept clear of trees and obstructions which may cause mechanical damage to insulation. Under such conditions economics may well favor no more protection than that provided by the transformer primary fuse.

Multiple vs Single Thermostats

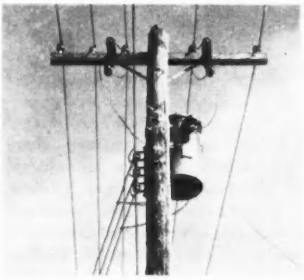
D. I. GALOR
New York Power & Light Co
Albany, N. Y.

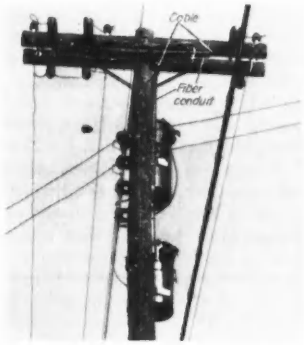
In temperature control of heated liquids, as in plating and washing operations, it may be more economical to use a number of expansion type thermostats with built-in switches, rather than one thermostat or thermocouple relaying to a magnetic switch. This has been found to be the case in the plant of W. & L. E. Gurley, instrument makers of Troy, N. Y., where there are several chrome plating, washing and rinsing operations, all electrically heated and some quite large.

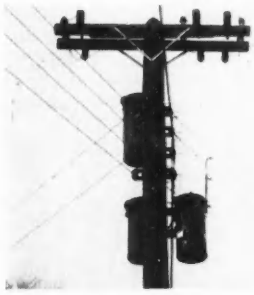
Temperature of each bath is controlled by one or more expansion thermostats, each capable of handling directly 25 amp—over 5 kw at 220 v. The immersion heaters in the larger baths are divided into groups of 5 kw or less, with individual control.

Safer Mounting Arrangement for Distribution Transformers

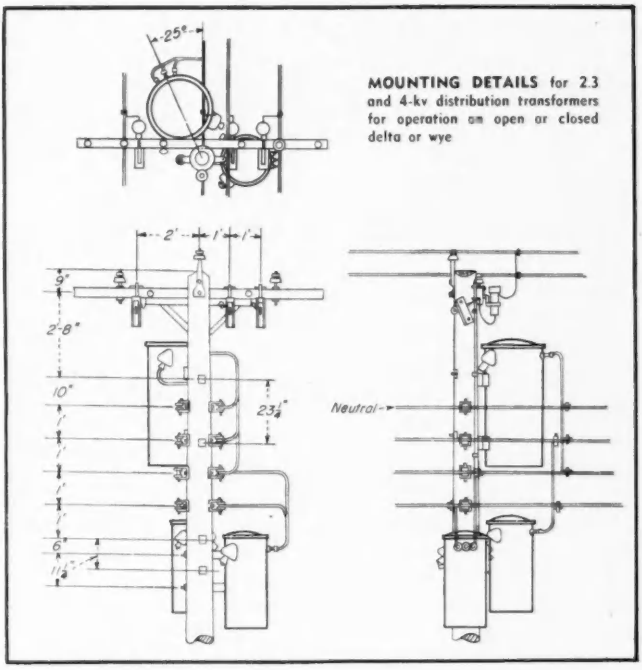
Use of 2-in. fiber conduit eliminates all open high-voltage risers on open or closed-delta installations







THREE INSTALLATIONS: Single-phase transformer (top) set at angle. For open delta, add second transformer (center) directly under the first. For closed delta, add transformer (bottom)



MOUNTING DETAILS for 2.3 and 4-kv distribution transformers for operation on open or closed delta or wye

G. W. McCRACKEN
Chief Engineer
Birmingham Electric Co
Birmingham, Ala.

GREATER safety, simplified wiring, increased reliability, and more pleasing appearance are obtained by a new location arrangement of 2,400 and 4,000-v distribution transformers on the pole.

Single-phase installations consist of a direct pole-mounted transformer set at an angle to the route to clear the secondary wires without the use of offset brackets. Open wire primary connections can be used on single-phase installations as the high-voltage bushings are near the primary cross arm and above service drop connections.

Three-phase installations are made by using two or three single-phase transformers, direct pole mounted. For an open-delta installation, the second transformer is installed directly below the standard single-phase position. For closed-delta installations, the third transformer is installed slightly lower on the pole than the second unit and around the pole from it, as shown in the drawing and pictures. 5000-v cable is run down the pole from the cutouts to the transformer in 2-in. fiber conduit to eliminate all open high-voltage risers on open or closed-delta installations.

Fluorescent Lighting Costs

Diversity of types and sizes of fluorescent sources prevents generalized conclusions on costs, except that, at the moment, the 40-w, T-12 lamp seems to have the edge

R. G. SLAUER
Manager, Applications Engineering
Sylvania Electric Products Inc.
Salem, Mass.

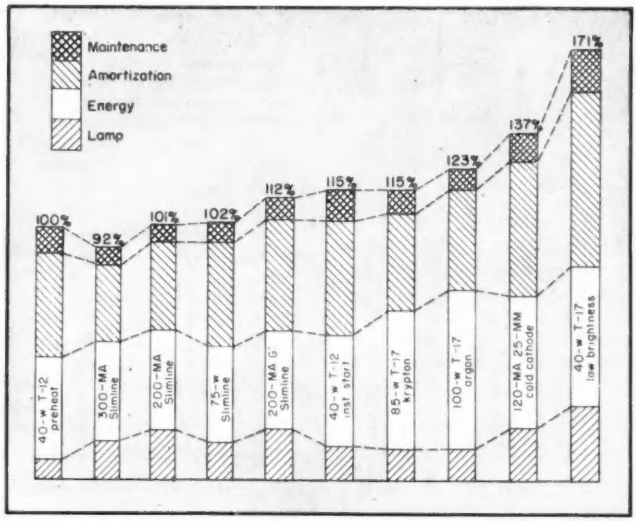


FIG 1—FOR INDUSTRIAL LIGHTING with separate fixtures, costs remain fairly level over a considerable range of fluorescent types

MUCH has been written about fluorescent lamps for general lighting. Too often such discussions fail to indicate that fluorescent is a generic term and that there are a number of differences in the effectiveness of application of commercially available types.

The earliest catalog listings did not include the 40-w 48-in. T-12 lamp which today is used in greater quantity than all others combined. Partially because of inherent engineering balance, but also because of pioneering sales concentration and the restrictive effect of the war, the 40-w T-12 lamp has not been challenged seriously. But such challenges are appearing and the second decade of fluorescent lighting is certain to see

TABLE I—Economic Comparison of Various Fluorescent Sources

CONDITIONS OF PROBLEM—It is desired to illuminate 1000 sq ft of industrial area, part of a more extended area, to a level of 40 ft-c. The local energy rate is 1¢ per kwhr, the lighting is to be operated 4000 hr per year; the area is reasonably clean; the units are to be mounted at 10 ft, the ceiling being 13 ft high. All fixtures are assumed to include industrial type porcelain or synthetic enamel steel reflectors.

	Two-lamp, 40-w, T-12 Preheat	Two-lamp, 40-w, T-12 Instant Start	Two-lamp, 40-w, T-17 Instant Start	Two-lamp, 85-w, T-17 Preheat	Two-lamp, 100-w, T-17 Preheat	Two-lamp, 75-w, 8-ft T-12 Slimline	Four-lamp, 200-ma, 8-ft T-8 Slimline	Four-lamp, 300-ma, 8-ft T-3 Slimline	Four-lamp, 200-ma, 6-ft T-8 Slimline	Four-lamp, 120-ma, 8-ft 25-mm Cold Cathode
1. Lamp output—lumens	2320	2320	2320	4400	4400	4800	3200	4200	2350	2100
2. Dual ballast loss—watts	15.5	28	38	38	32	38	28	40	24	16
3. Coefficient of utilization	0.65	0.65	0.57	0.57	0.57	0.65	0.65	0.65	0.65	0.65
4. Maintenance factor	0.65	0.65	0.60	0.60	0.60	0.65	0.65	0.65	0.65	0.60
5. Number of luminaires	20.4	20.4	25.4	13.3	13.3	9.9	7.4	5.7	10.0	12.2
6. Cost per luminaire	$ 15.75	$ 18.50	$ 24.00	$ 26.25	$ 26.25	$ 38.00	$ 45.00	$ 50.00	$ 40.00	$ 40.00
7. Total cost of luminaire	$321.30	$378.00	$609.50	$349.00	$349.00	$377.00	$333.00	$285.00	$400.00	$488.00
8. Installation per luminaire	$ 8.00	$ 8.00	$ 8.50	$ 8.50	$ 8.50	$ 10.50	$ 10.50	$ 10.50	$ 10.00	$ 10.50
9. Total installation	$163.20	$163.20	$215.90	$113.00	$113.00	$104.00	$ 77.00	$ 59.80	$100.00	$128.00
10. Lamp life—hours	7500	6000	6000	7500	7500	6000	6000	6000	6000	12,000
11. Unit lamp cost	$ 0.70	$ 0.84	$ 1.61	$ 1.61	$ 1.61	$ 2.27	$ 1.89	$ 1.89	$ 1.40	$ 2.45
12. Annual lamp cost	$ 15.23	$ 22.85	$ 54.50	$ 22.80	$ 22.80	$ 30.00	$ 37.30	$ 28.80	$ 37.50	$ 40.00
13. Energy cost—1¢ rate	$ 77.93	$ 88.10	$109.60	$109.50	$123.50	$ 74.50	$ 77.00	$ 81.00	$ 80.00	$105.50
14. Amortization—16 2/3%	$ 80.75	$ 90.20	$137.57	$ 77.00	$ 77.00	$ 80.17	$ 68.45	$ 57.50	$ 83.30	$102.60
15. Cleaning cost per unit	$ 0.35	$ 0.35	$ 0.40	$ 0.40	$ 0.40	$ 0.50	$ 0.55	$ 0.55	$ 0.45	$ 0.55
16. Total cleaning—Biannually	$ 14.28	$ 14.28	$ 20.32	$ 10.60	$ 10.60	$ 9.90	$ 8.15	$ 6.28	$ 9.00	$ 13.40
17. Unit lamp replacement cost	$ 0.30	$ 0.30	$ 0.30	$ 0.30	$ 0.30	$ 0.35	$ 0.35	$ 0.35	$ 0.30	$ 0.35
18. Total lamp replacement cost	$ 6.53	$ 8.16	$ 10.16	$ 4.23	$ 4.23	$ 4.62	$ 6.90	$ 5.32	$ 8.00	$ 5.70
19. Total annual cost	$194.72	$223.59	$332.15	$224.13	$238.13	$199.19	$197.80	$178.90	$217.80	$267.20
20. Relative cost—Percent	100	115	171	115	123	102	101	92	112	137

some shift in emphasis. One might wonder why this forecast, even if correct, deserves much attention. The answers are to be found in the dependence of any fluorescent lamp on the fixture and circuit elements, plus the growing integration of lighting with architecture. Unlike the incandescent lamp, a change in wattage or shape involves more than just replacing a lamp.

All fluorescent lamps have characteristics which make them distinct from other sources. They are of low surface brightness, of high efficiency, of shape, and of low wattage concentration. Every one of these is associated with concepts of good lighting and has contributed to application acceptance. The challenges which have arisen are due to special features, or attempts to be certain that good lighting is achieved at low cost or with more practical tools.

While there are frequently several reasons why one fluorescent lamp differs from another, the main trends in development have been along the the following lines: (1) Longer life, (2) instant starting, (3) architectural and (4) higher total output.

The advantages of longer life are obvious provided the method used does not require a disproportionate sacrifice in efficiency or other desirable goal. Whether or not this is achieved by 10,000-hr or longer lived cold-cathode lamps is a matter of opinion. Certainly the economic comparison in Table 1 does not favor the cold-cathode lamp for the broad application used as a basis, although positive conclusions should not be drawn from single examples. So-called "standard" fluorescent lamps (thermionic rather than shell electrodes) have materially improved in life performance during recent years.

Whether instant starting deserves the attention given to it represents another difference of opinion. There is no indication that it can be achieved except through some sacrifice in lamp life, ballast size, ballast efficiency, or all three. But it is being recognized that these adverse factors are minor in magnitude compared with over-all economic or design factors. To some, the important gain is the elimination of starters. As mechanical functioning devices, they represent additional circuit trouble points despite tremendous advances in design and reliability.

The earliest advocates of fluorescent lighting emphasized its possibilities as an architectural tool. Except for problems of mass production and distribution, there seems to be no reason why fluorescent lamps cannot meet any reasonable architectural goal and many apparently unreasonable ones. Already continuous rows of surface mounted lamps or luminaires are commonplace, built-in appli-

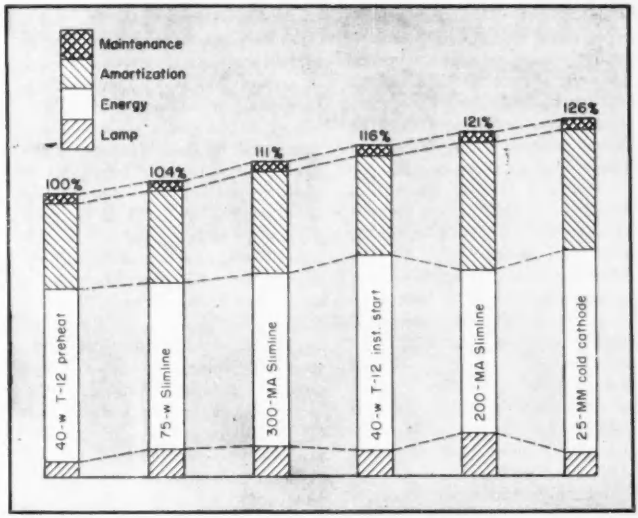


FIG 2—COST RANGE is not wide when continuous strip lighting is used in industrial areas

TABLE II—Economic Comparison of Continuous Strip Fluorescent Sources

CONDITIONS OF PROBLEM—It is desired to illuminate a general area (for example, through a louvered ceiling) using continuous rows of fluorescent lamps mounted on wiring strips. The 4-ft T-12 lamps when strips are located 24 in. apart might produce 75-100 ft-c depending on the over-all conditions. Assuming that the other sources will give results proportionate to their output per unit length the strips are placed correspondingly closer or further apart to result in the same level of light. The local energy rate is 2¢ per kwhr; the lighting is to be operated 3000 hr per year; and the area is considered reasonably clean with no special provision for fixture cleaning which would not be identical for all systems. For convenience a 16-ft length of strip is assumed in the calculations.

	8-ft Strip Two-lamp 40-w, T-12 Preheat	8-ft Strip Two-lamp 40-w, T-12 Instant Start	16-ft Strip Two-lamp 200-ma, 8-ft T-8 Slimline	16-ft Strip Two-lamp 300-ma, 8-ft T-8 Slimline	16-ft Strip Two-lamp 75-w, 8-ft T-12 Slimline	16-ft Strip* Two-lamp 120-ma, 8-ft 25-mm Cold Cathode
1. Lamp output—lumens	2320	2320	3200	4200	4800	2100
2. Dual ballast loss—watts	15.5	28	28	40	38	32
3. Spacing of Strips	24 in.	24 in.	16½ in.	22 in.	25 in.	11½ in.
4. Relative number of luminaires	2	2	1.45	1.1	.967	2.2
5. Cost per luminaire	$12.41	$15.02	$23.80	$26.90	$28.96	$12.00
6. Total cost of luminaire	$24.82	$30.04	$34.50	$29.60	$28.00	$26.40
7. Installation per unit	$ 5.00	$ 5.00	$10.00	$10.00	$10.00	$ 8.00
8. Total installation cost	$10.00	$10.00	$14.50	$11.00	$ 9.67	$17.60
9. Lamp life	7500	6000	6000	6000	6000	12,000
10. Unit lamp cost	$ 0.70	$ 0.84	$ 1.89	$ 1.89	$ 2.27	$ 2.45
11. Annual lamp cost	$ 1.12	$ 1.68	$ 2.74	$ 2.08	$ 2.19	$ 1.28
12. Energy cost—2¢ rate	$11.48	$12.95	$11.30	$11.72	$10.90	$14.75
13. Amortization—16 2/3%	$ 5.80	$ 6.67	$ 8.17	$ 6.77	$ 6.28	$ 7.33
14. Unit lamp replacement cost	$ 0.30	$ 0.30	$ 0.40	$ 0.40	$ 0.40	$ 0.40
15. Total lamp replacement cost	$ 0.48	$ 0.60	$ 0.58	$ 0.44	$ 0.39	$ 0.44
16. Total annual cost	$18.88	$21.90	$22.79	$21.01	$19.76	$23.80
17. Relative cost—Percent	100	116	121	111	104	126

* It is assumed that the cold cathode installation is part of a high voltage series installation mounted directly on the ceiling. Since most such installations are custom built, unit costs, lamp data, and performance data are not standardized and the figure given must be interpreted broadly. It is felt that they fairly represent the over-all picture of the use of this source.

cations such as troffers and coves well accepted, and new concepts such as completely louvered ceilings beyond the novelty stage. Such applications have emphasized longer sources. National manufacturers of stock luminaires are now selling 16-ft strips although thus far their longest lamp is 8 ft. Cold cathode lamps with their great possibilities of custom-built designs are foremost in certain architectural fields.

There has been a feeling that higher output concentrations of later lamp designs would show an economic advantage over the 40-w T-12 lamp. The 100-w T-17 lamp (with its present companion, the 85-w krypton-filled T-17 lamp) has not proven this point. It has certain advantages, usually for specific rather than general reasons. However, two new lamps which are higher in output (if not in concentration) show approximate economic equality while holding on to certain good characteristics of their own. These are the 300-ma 8-ft T-8 Slimline, and the 75-w 8-ft T-12 Slimline.

One other characteristic has been used as a criterion for development—low brightness. Only one lamp has been made available specifically for this purpose (the 40-w T-17) although the 100-ma Slimline might also be included. Accompanying charts show the economic handicap inherent with this source. The author feels that desired quality goals can be achieved by less extreme lamps used in properly designed luminaires without economic penalty.

Two economic studies have been used in the accompanying charts and tables. One (Table I, Fig 1) is representative of a broad and important application, the use of individual luminaires. Many of these are connected to existing outlets which are a carryover of the incandescent luminaire thinking which has dominated the field of illumination and architecture for 50 years. The second study (Table II, Fig 2) is far more representative of today's lighting trend. This covers the use of continuous lines of light. Often these may be luminaires similar to those used on individual outlets but mounted end to end; just as often they take the form of single lamps mounted continuously bare on the ceiling, on strips or other single wiring channels, or in recessed units, such as troffers.

A close study of such data tends to explain the apparent over-complexity of present fluorescent lamp listings. Depending on the application, it is almost certain that a good economic case could be made for any of the more popular lamps. When to this is added special factors, even a probable uneconomical lamp such as the 40-w T-17 lamp finds a place. It is reasonable to assume that in the ever expanding use of lighting usage, more rather than less variations will be encountered. Details of these may be left to the architect, the plant construction department, the electrical crew, the lighting salesman or consultant. From the overall standpoint, the executive or engineer in other fields may confine himself to:

1. An understanding of the basic features of all fluorescent lamps.
2. An appreciation of the objectives which might be gained by the choice of one particular type.
3. An acceptance of economic analyses to assist in the final choice when basic objectives are outlined.

For specific lighting problems, it is possible to determine an economic relationship between incandescent and fluorescent lamps*, and between the many particular types of fluorescent lamps currently available. To expand such comparisons into guiding principles for light source and accessory manufacturers and for all users depends on selecting very broad goals and making quite broad assumptions. Nevertheless this is often necessary and within limitations certain of these principles may be expressed:

1. For the general lighting of large areas, accepted methods of incandescent lighting tend to be somewhat more costly on an annual basis than fluorescent lighting.
2. Certain characteristics of fluorescent lamps lend themselves so readily to the attainment of concepts of good illumination that a high cost penalty must be assessed if incandescent lamps are required to achieve these same goals.
3. The characteristics of fluorescent lamps which make them so flexible for architectural lighting treatments have resulted in the availability of many forms of this source.
4. No particular fluorescent lamp is basically cheaper to use than another since every factor which enters into the cost of lighting tends to shift in emphasis with varying conditions.
5. Since most fluorescent lamps lie within a reasonable cost span, factors to which no general economic value could be assigned often become the determining factor of usage.
6. While fluorescent lighting has matured rapidly, there is no indication that the future is in any sense restricted either from a developmental or an application standpoint.

* In a previous article, Electrical World, April 9, 1949, Page 91, Mr. R. G. Slauer examined the comparative costs of fluorescent and incandescent lighting.

Fewer Variations in Design Are Needed

An Editorial in Electrical World, *April 16, 1929*

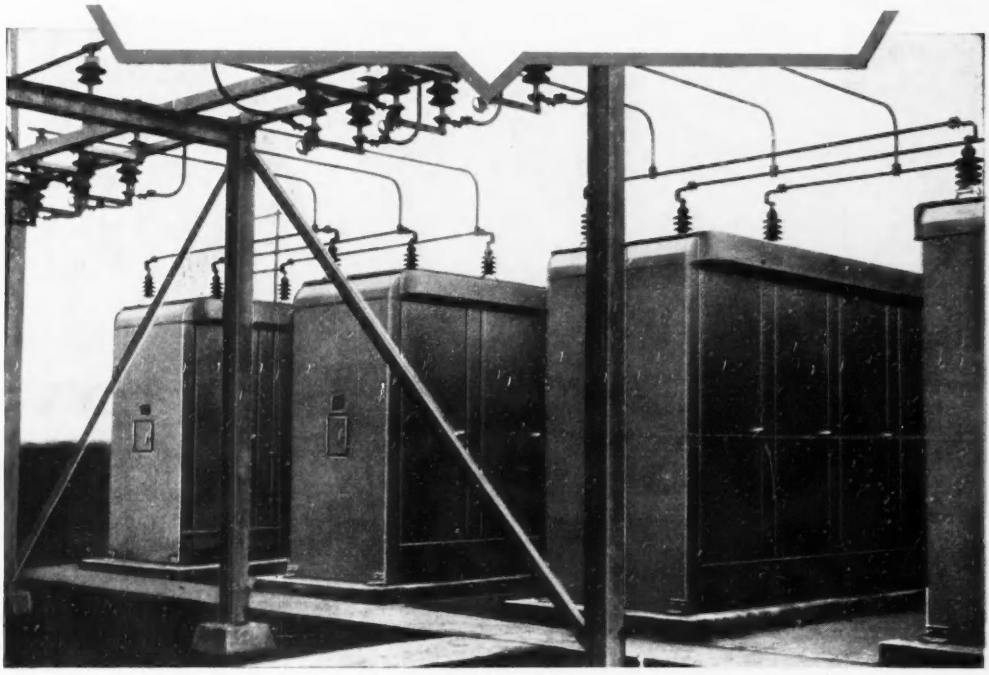
THERE CAN be no ultimate justification for the many variations in design of electrical equipment. More than one thousand different oil circuit breakers, for instance, are available for the selection of the electrical engineer. These average one hundred sales per year. It is not to be doubted that, outside of the pride of the designer, the opinions of the purchasers and the ensuing claims of the manufacturer, no real reason for the existence of so many as one hundred such variations exists.

If these amazingly numerous manifestations of individualism were productive of equipment which met more closely the demands of specific service conditions, they would be more understandable; but when the results are viewed with the necessary perspective of time and space, there is little apparent except that imagination and opinion have again run riot without producing any priceless jewel of achievement.

New Capacitor Equipments

using 25-kvar capacitors

Cut Installed Cost



This is one of the largest installations of capacitor equipments made to date. It consists of General Electric 5100-kvar equipments of the newest design, employing 25-kvar Pyranol* capacitors with glass bushings.

General Electric has recently introduced a new line of power capacitor equipments using 25-kvar capacitors. Price of the equipment, including capacitors, is materially lower per kvar than those previously available. The housing is about 30% smaller, cutting foundation costs and saving space. And the number of individual capacitors is reduced 40%.

MANY IMPROVEMENTS TOO

Besides their lower installed cost and smaller size, these new equipments bring you several improvements that will interest operating personnel: The roof terminal bushings are arranged so as to simplify bus work, particularly where banks are used. Improved interlocking of doors with line breakers and grounding switches precludes possibility of reaching charged capacitors. Thermostatically-controlled fans provide air circulation within the housing when needed.

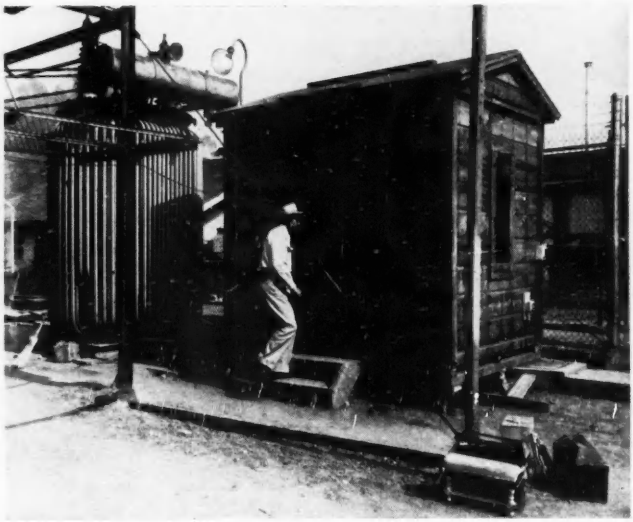
For information on these equipments, call your G-E sales office. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

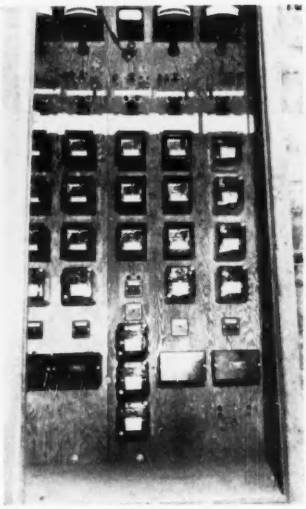
*Reg. U.S. Pat. Off.

GENERAL ELECTRIC

HOW TO DESIGN • CONSTRUCT OPERATE • MAINTAIN

Portable Control Houses Speed Substation Modernization





PORTABLE temporary control house (left) used by Southern California Edison Co on substation modernization jobs. It provides control during time old substation switchboards are being replaced, cuts outage time to an absolute minimum. Standard switchboard instruments are mounted on a plywood panel (right), wired to terminal boards. Board is equipped with all instruments and controls required for normal operation, including overcurrent, ground, reclosing and differential relays and various time and control switches

E. B. RYNN
Supt of Substation Construction
Southern California Edison Co
Los Angeles, Calif.

PORTABLE TEMPORARY CONTROL houses have cut outage time and improved operation during substation modernization of Southern California Edison Co. Standard switchboard instruments on plywood panels are used to operate the station while old equipment is being replaced and additional new circuits installed.

The portable houses were developed to replace temporary operating expedients often used when a station remains in operation during extensive remodeling. Edison's systemwide program of substation modernization warranted the development of such a unit which could easily be moved from one substation to another.

The houses have been built for two general classes of substations—up to four circuits and up to eight circuits. First one built has been in use nearly a year on different jobs, with excellent results. Original construction was of wood, as shown, but Edison is now using sheet metal, which is lighter and more durable. Its 8x8-ft plywood panel provides service for six line positions, one bank position, one bus tie position and one street light position. A metering position and extra line position are on separate individual panels.

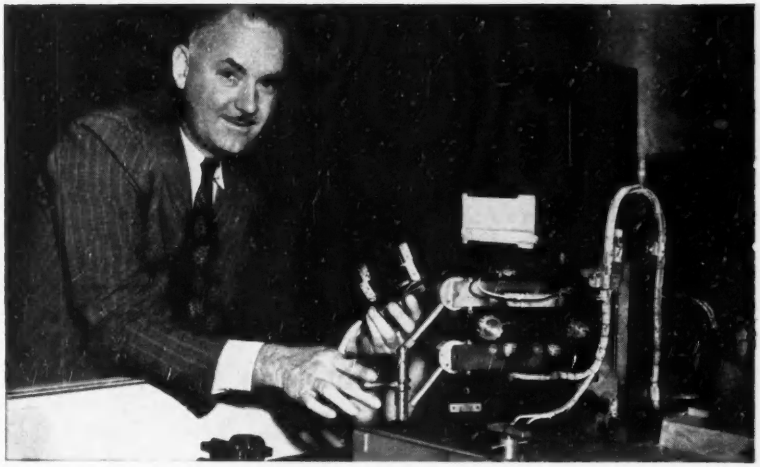
Transfer Operations

After the temporary house has been located at the substation, control of old equipment is transferred to it while new switchboards are being installed. New circuits are put in service as they are completed and controls transferred one at a time back to the new substation equipment. Control cables are cut to final length and coiled on racks on the back of the house for storage during temporary operation.

Modernization Time Cut

When the job is completed the house is loaded on a truck and moved to the next job. Since it is mounted on skids and all wiring is complete to terminal boards, moving and setting up are simple operations. Use of these portable control houses has cut the time required for modernization by 10 to 20%. Their greatest value, however, has been in systematizing and simplifying operation during construction.

— new facilities assure —
— accuracy and uniformity in —
— new I-50 watthour meter! —



This electronically controlled power-factor adjusting device is one of the many pieces of new equipment designed especially for I-50 production. It permits the electromagnet to be accurately lagged before installation in the meter—another assurance of accuracy and uniformity in the I-50.

The I-50 watthour meter is completely new from terminals to cover—and so are the facilities we've using to produce it. We've equipped an entire new plant—from screw drivers to assembly lines—with the most modern equipment for I-50 production.

And what are your benefits? With every I-50 order you place, you get a meter with greater sustained accuracy, longer life, and lower maintenance costs than ever before possible. These benefits result from our modern facilities, plus specially trained personnel, rigid quality control, and precision manufacturing techniques.

H. H. Campbell

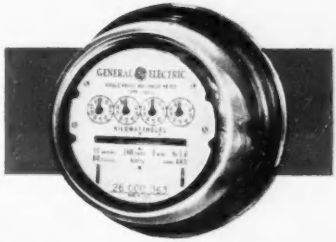
Superintendent of Meter Manufacturing
Meter and Instrument Divisions
West Lynn, Massachusetts

Type I-50, the first completely new watthour meter in 50 years

Place your order for socket- or bottom-connected types with your nearest General Electric representative. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

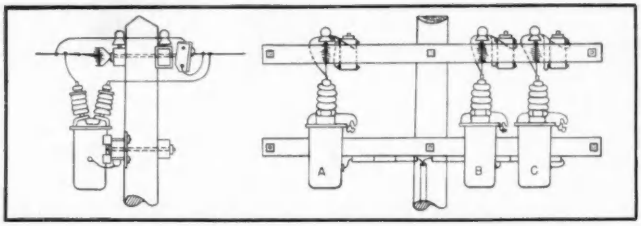
NEW FEATURES FOR LOWER MAINTENANCE

1. Co-ordinated insulation—for better performance under adverse operating conditions.
2. Magnetically suspended rotating element—to do away with bearing maintenance.
3. Braking magnets die-cast in frame—to assure calibration stability.
4. Current coil molded in butyl and potential coil in polyethylene—for greater insulation and stability.
5. One-piece molded "S" base—to minimize corrosion.



GENERAL ELECTRIC

Systematized Recloser Practice



RECLOSERS are mounted on standard six-pin arms following established practice

L. J. BRADBURY
Supt of Distribution
Plymouth County Electric Co
Plymouth, Mass

For recloser type circuit breakers, the Plymouth County Electric Co has established the following practice: Pole mountings use standard six-pin arms. By-pass cut-outs are normally open. Reclosers are identified as *A*, *B* and *C* for three phase, with *B* omitted on single-phase installations. Designations are from left to right when facing away from the substation. All circuits and branches having reclosers are equipped with solid disconnects. With the disconnects closed, the circuit is always considered alive regardless of whether the reclosers are in the closed or the open position. To work a circuit "dead" the disconnects must be open. To de-energize the reclosers the following steps are taken: (1) Close cutouts; (2) manually operate the recloser to the open position; and (3) disconnect hot leads. Each unit is installed so that the operating mechanism is on the pole side of the recloser.

An operation counter shows the number of openings of the recloser contacts. This helps to determine the usefulness of the reclosers and aids maintenance. A notebook is provided at the location of each set. Each time the poles supporting the reclosers are climbed, the counters are read and the readings recorded, with comments. For example:

Recloser	Date	Reading	Comment
A	Aug 10, 1948	0024	Lightnin
A	Sept 16, 1948	0028	Wire Down

Low Cost Low Bed Trailer

Colorado State Patrol Photo

LOW-BED TRAILER for transporting snow tractors, built for $425 by Public Service Co of Colorado. Simple design and all-welded construction kept cost down

F. E. RAGLIN
Asst. Transportation Engineer
Public Service Co of Colorado
Denver

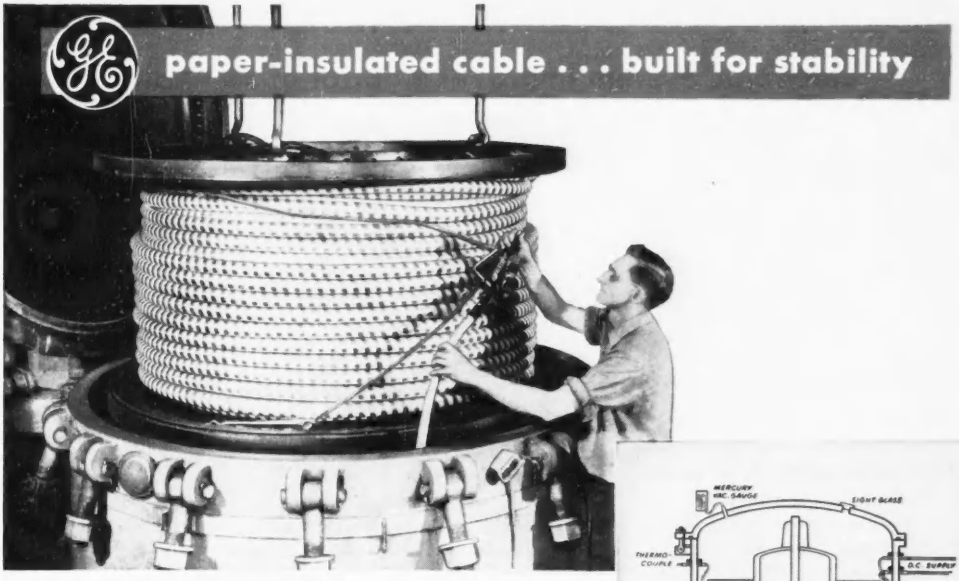
To transport snow tractors, Public Service Co of Colorado designed and built for only $425 the low-bed ton-and-a-half trailer shown. The low total cost resulted largely from simple design and all-welded construction with standard materials.

Three surplus army snow tractors and one post-war unit are used in winter patrol on some of the company's most important transmission lines. They were previously transported on ton-and-a-half flat-bed trucks. Loading the units by driving them up long skids to the high truck bed was awkward and unsafe, both for men and equipment.

Trailer Was Chosen

A low-bed single axle trailer was chosen as the answer. It was fabricated in three days by three men in the company shops. A single torsion spring axle provides 3,000 lb capacity, with road clearance of 10 in. Tires are 6.50 by 16, six ply; brakes are electrically operated.

Two small unloading ramps are 28 in. long, 14 in. high and weigh only 30 lb. The trailer is 14 ft long and overall width is just under 8 ft, tapering to 4 ft 8 in. at the front. It will accommodate either type tractor without any adjustments.



VACUUM-DRIED . . . *electrically*

—to give uniform quality, long cable life!

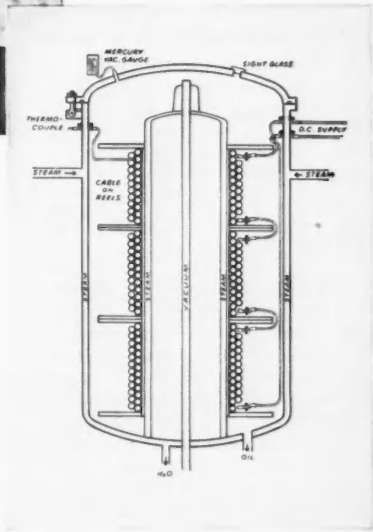
It's only one example, but *electric* vacuum-drying is typical of the extra care that goes into the making of General Electric paper-insulated cable, solid and gas-filled types. By means of this exclusive process, all air and moisture is removed from the assembled cable prior to impregnating, and the cable is heated and dried *uniformly* throughout. This leads to *uniform* quality that assures you of long years of cable service.

Test after test for cable quality!

In many other ways, too, General Electric makes sure of the quality of the cable you get. Over 25 different tests are made on the copper, paper, oil and lead used. Special machines of G-E design, equipped with automatic constant-tension devices, apply paper to the conductors with even-spaced uniformity. Insulation is applied in a special, constant-humidity room, to maintain uniformity of paper tension after moisture is removed.

Complete control for dependability!

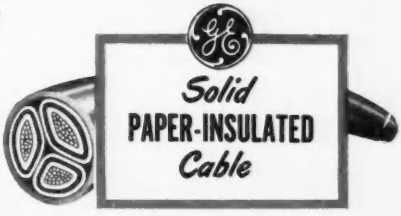
As a further control, each cable is tested 14 different times during manufacture, with over 40 different points checked! With precision methods like these, you can depend on every foot of G-E paper-insulated cable. Check with your local G-E representative on what savings it can mean to you. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*



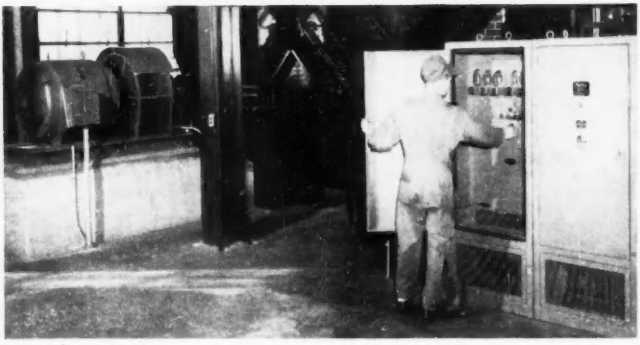
Here's how it's done!

Before impregnating and leading, reels of General Electric paper-insulated cable are placed in a steam-jacketed drying tank, as shown in photo and diagram above. Conductors are attached to vacuum-tight leads connected to high-current generators. The heat generated is *inside* the cable where it is most effective—assuring uniform heating and drying during the vacuum process. Steam, introduced around the tank and in the center dome, maintains constant temperature throughout the tank. Thus—electrically-uniform heating and drying are obtained throughout the cable's length.

GENERAL ELECTRIC



Electronic System Improves Control of Fan Speed



ELECTRONIC CONTROL automatically adjusts fan speed for best combustion

W. F. NELSON
Manager of Steam Stations
E. W. JAMES
Assistant Chief Engineer
Wisconsin Public Service Corp
Green Bay

Both sensitivity and speed adjustment of power house fans are improved by controlling the magnetic coupling electronically instead of by the usual exciter rheostat method.

This conclusion is based on recent experience with one of each type of control. The initial installations of magnetic couplings in 1943 for induced and forced draft fans used rheostat type of control. These drives, applied to Unit No. 3 in Pulliam Bayside Plant, have direct connected generators that supply direct current for magnetization. The most recent installation is for Unit No. 4 in the same plant and the magnetic couplings are electronically controlled.

Magnetic Couplings

Two forced draft and two induced draft fans use an electronic system developed by engineers of the Electric Machinery Manufacturing Co. The magnetic couplings on the forced draft fans are driven by 200-hp motors operating at 1,175 rpm. Those on the induced draft fans are driven by 350-hp, 870-rpm motors. The electronic control system is rated 250 v 15 amp with a 3.75 kw d-c output. The fans are installed on a boiler capable of making 312,500 lb of steam per hour when supplying the turbine with steam at 650 psi, 900 F and are equipped with a fully automatic combustion control system.

With the electronic control, the adjustable d-c supply for magnetic coupling is supplied from an a-c source through a rectifier circuit. For control, this rectifier circuit has a small tachometer generator on the fan shaft and a variable rheostat which is controlled by the automatic combustion control system used with the boiler.

Demand Determines Fan Output

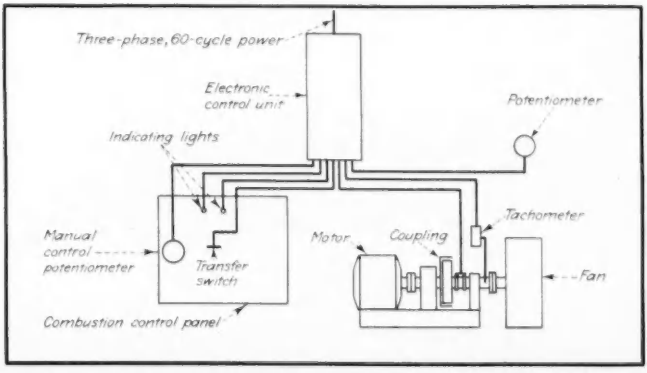
This control system regulates the amount of energizing direct current to the magnetic coupling. This either increases or decreases the output of the forced or induced draft fans depending upon the demands of the combustion control system.

The rectifier portion of the circuit consists of six grid controlled, gas filled, power rectifier tubes operating in parallel. These tubes can give the unit full load capacity when only four tubes are operating. Because of this, tube failures produce no operating disturbances as long as four remain in service. Tube life has been favorable but shorter than originally expected. One of the reasons for this may be that the units are operating in a rather high ambient temperature. Tube life of the amplifier portion of the system which works in conjunction with the electrical tachometer has been very good and the original tubes are reported as still being in service.

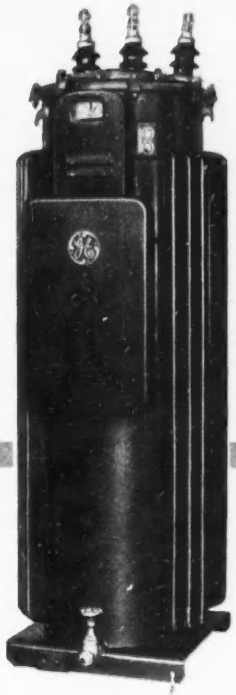
Stability Control

Sensitivity of the basic circuit is such that a change of 0.003 v in the tachometer generator will result in a swing to either zero or full excitation, depending upon whether the speed is too high or too low. Because of this sensitivity, an anti-hunt circuit and a snubbing circuit are provided to insure stability.

In service the electronic control system is adequately fast in responding to load changes and is much faster than the exciter rheostat type of control employed on the first installation.



FORCED DRAFT fan is driven by 200-hp, 1,140 228-rpm magnetic drive that is electronically controlled. Anti-hunt and snubbing circuits are provided to insure system stability



The Regulator you asked for!

We took stock! We made a careful digest of all comments and suggestions that we had received from you in the electric utility industry as to what you wanted in single-phase induction-voltage regulators.

The result: a new Type IRS Regulator—the regulator you asked for.

It still has the high accuracy, the narrow band width, and the immediate response that you praised in G-E regulators. It will continue to require practically no maintenance—the characteristic that has made the G-E induction voltage regulator one of the most dependable and satisfactory equipments on central-station lines.

And now it is . . .

EASIER TO INSTALL!

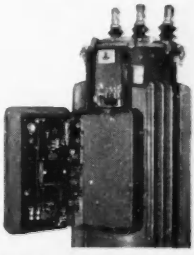
- The new rectangular base provides greater stability, gives ample clearance for jacking and allows you to move the regulator in any direction on rollers.
- The clamp-type bushing terminals accommodate a wider range of cable sizes.
- New copper-faced ground pad has bolts spaced for NEMA terminals.

EASIER TO ADJUST!

- Adjustment for holding effect in voltage-regulating relay is now made with a single-dial rheostat.
- Manual control now operates directly in the motor circuit.
- Terminals for current testing, as well as potential testing, are now conveniently located on front of panel.

Our new booklet GEA-2985 contains a complete description of this new regulator. If you have not received your copy, write your nearest G-E district office or *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

You asked for a place to put testing instrument. The new regulator has a shelf built into the control cabinet door which locks the door open, keeps it from swinging, and at the same time provides a handy place for portable instruments. Note the good appearance of the semi-flush control panel.



You asked for more accessibility. In the new regulator, the entire control panel swings open, exposing all the wiring and connections making all control components readily accessible for maintenance and inspection.

GENERAL ELECTRIC

Pawtucket serves a 1725-KW

For low-cost dependability and flexibility—today and tomorrow

Many people think of secondary networks as suitable only for very large loads, covering a sizable area, and arranged in a conventional grid pattern. Yet here is a case where an initial network will supply an area with a total peak load of 1725 kilowatts—and with the secondary mains confined essentially to a 600-foot portion of a single street.

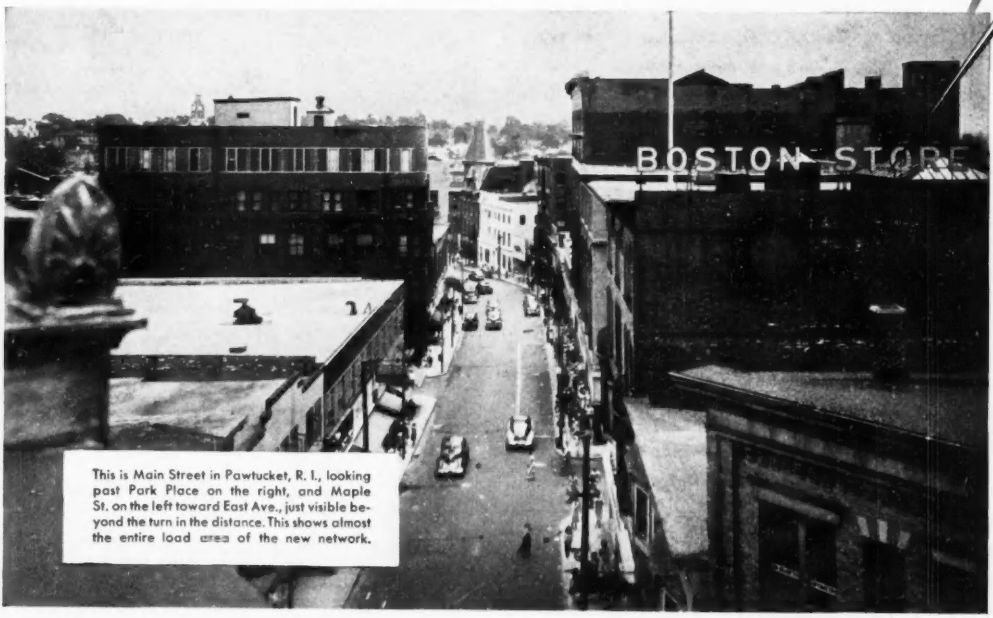
The city is Pawtucket, R. I., served by the Blackstone Valley Gas and Electric Company. The installation, as originally engineered, involved a two-block business district on Main Street, between High and North Union.

Load growth was the problem

This portion of the business district has been served by a radial system, principally underground. There are thirteen grouped loads to be served—with peak requirements from 40 to 240 kw. With buildings recently modernized, three recently air conditioned, it seemed only a matter of time before growing load would make the present radial system inadequate.

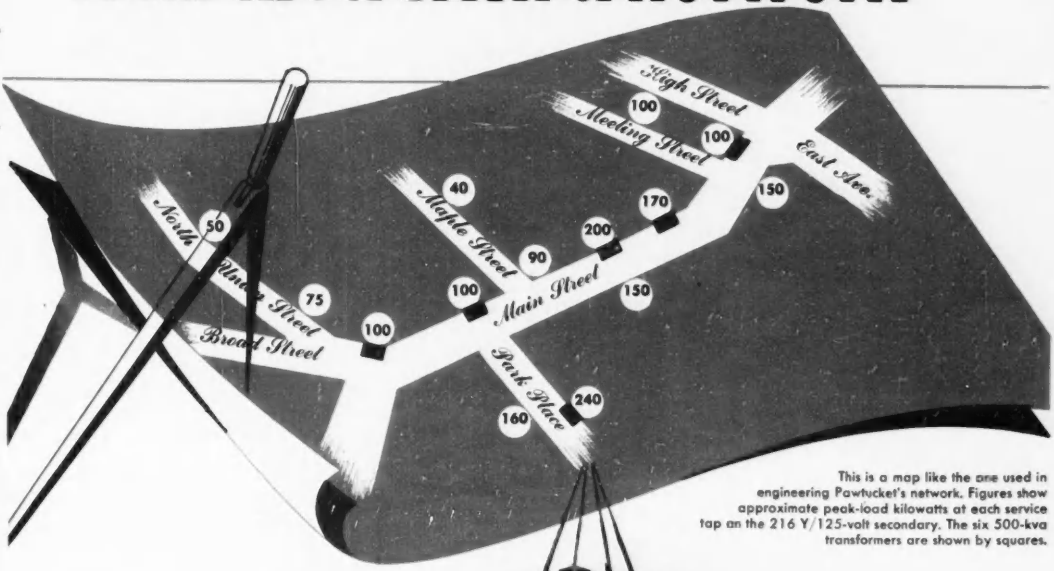
A network proved practical

The situation seemed to call for a network, and study proved that all requirements of an ideal network could be met economically—including proper loading of transformers and cables during both normal and abnormal conditions, while maintaining close voltage tolerances. Three 14,400-volt primary feeders were used with six 500-kva standardized network units—trans-



This is Main Street in Pawtucket, R. I., looking past Park Place on the right, and Maple St. on the left toward East Ave., just visible beyond the turn in the distance. This shows almost the entire load area of the new network.

load area with a network



This is a map like the one used in engineering Pawtucket's network. Figures show approximate peak-load kilowatts at each service tap on the 216 Y/125-volt secondary. The six 500-kva transformers are shown by squares.

formers and protectors. This gave a load-to-transformer ratio of 57.5% – about average for initial network installations.

Present load can increase seven-fold without adding primary feeders or increasing size of secondary mains

With an initial transformer loading of less than 60%, this installation will provide full network flexibility. Some increase – and shifting – in load can be handled with no excessive overload, even with one feeder out of service.

As load grows, it will, of course, be necessary to add transformers. However, no additional primary feeders will be required, and the size of secondary mains need not be increased. New loads within the present area will be handled by tapping into the present secondary network. New transformers will be tapped into existing primary feeders and tied into the existing secondary.

Present plans call for extending the network to include ten rather than six transformers and to cover three blocks rather than two.

Pawtucket gained by selecting standardized G-E transformers and protectors – cut delivery time, saved money over the cost of non-standard designs.

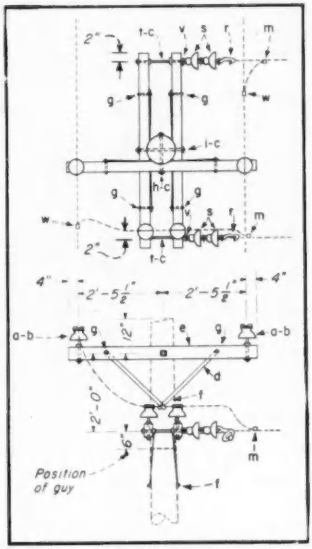
This installation brings out one of the big advantages of the secondary network—how, for high-quality service, it is the simplest and least expensive system to expand, the ideal system to meet growing loads. For additional information—and a copy of a new leaflet on secondary networks (GET-1487) — call your G-E representative or write Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC

402-78

Tapping Rural 7200-v Lines

Methods used by Central Maine Power Co to make single-phase taps



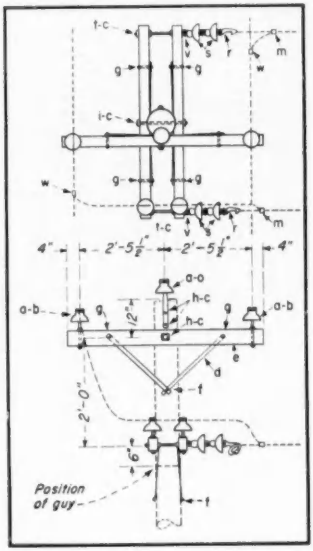
7200-v, 1-phase, Ungrounded

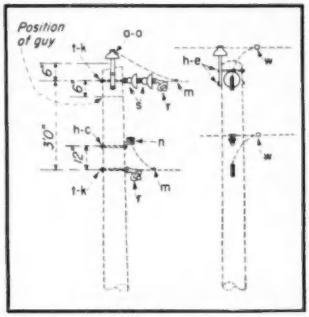
Item	Quan.	Material
a	4	Insulators, 15 kv
b	4	Steel pins
c	12	2 1/4-in. square washers
d	6	Crossarm braces
e	3	Crossarms
f	3	Toe bolt
g	6	Carriage bolts
h	1	Machine bolt
i	3	Space bolts
m	2	Connectors
r	2	Dead-end clamps
s	4	6-in. disk insulators
v	2	Eye nuts, round
w	2	Hot-line clamps

7,200 v, 3-phase, Ungrounded

(Tap may be on any two of three wires)

Item	Quan.	Material
a	5	Insulators, 15 kv
b	4	Steel pins
c	14	2 1/4-in. square washers
d	6	Crossarm braces
e	3	Crossarms
f	3	Toe bolts
g	6	Carriage bolts
h	3	Machine bolts
i	3	Space bolts
m	2	Connectors
o	1	Pole-top fixture
r	2	Dead-end clamps
s	4	6-in. disk insulators
v	2	Eye nuts, round
w	2	Hot-line clamps





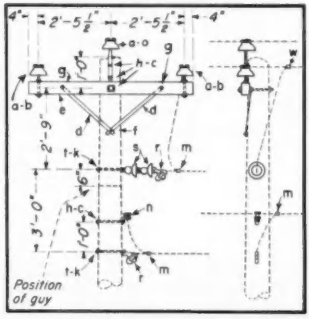
7200/12470 Y, 3-Phase, Grounded Neutral

(Tap may be off any one of three phase wires)

Item	Quan.	Material
a	3	Insulators, 15 kv
b	2	Steel pins
c	5	2 1/4-in. square washers
d	2	Crossarm braces
e	1	Crossarm
f	1	Toe bolt
g	2	Carriage bolts
h	4	Machine bolts
k	2	3-in. curved washers
m	3	Connectors
n	1	Neutral bracket
o	1	Pole-top fixture
r	2	Dead-end clamps
s	2	6-in. disk insulators
t	2	Eye bolts
w	1	Hot-line clamp

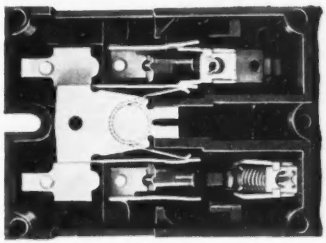
7200/12470 Y, 1-Phase, Grounded Neutral

Item	Quan.	Material
a	1	Insulator, 15 kv
c	3	2 1/4-in. square washers
h	3	Machine bolts
k	2	3-in. curved washers
m	2	Connectors
r	2	Dead-end clamps
s	2	6-in. disk insulators
t	2	Eye bolts
w	2	Hot-line clamps

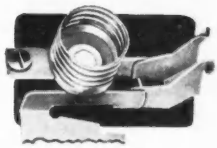


REVERE "KNOW HOW" made premium metal unnecessary!

Federal Noark NTPS Panelboard, made by the Federal Electric Products Company, Newark 5, N. J.



Showing the sure-contact spring in switch assembly.



These are the three current-carrying parts.

Once in a while Revere recommends that a customer switch to a metal that costs more per pound, because its use will make the finished part more efficient or less costly. On the other hand, sometimes economy can be achieved by specifying a non-premium metal. It all depends upon the nature of the finished part, the fabrication methods, and the conditions of use. Take this Federal Noark Type NTPS panelboard, a combination fuse block and circuit switch. The contact fingers in this originally were to be made of a special spring alloy carrying a premium of about 13¢ per pound. The question was asked, naturally enough, if this was absolutely necessary. Federal and the Revere Technical Advisory Service collaborated closely, and it was decided that electrolytic copper should be perfectly satisfactory if supplied in the proper temper, hardness and grain size. Samples as recommended by the Revere Technical Advisory Service were tested rigidly, and were found to perform perfectly. Revere is proud of this example of constructive collaboration with a customer, especially since the panelboard is meant for heavy-duty light and power control, handling 30 amperes. Operation is exceptionally fast, due to a powerful spring-actuated make and break, which reduces or eliminates arcing. There are only three current carrying parts, each heavy and rugged for trouble-free service. . . . Revere will be glad to cooperate with you in a mutual search for the non-ferrous metal that will be most economical in your product.

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COPPER AND BRASS INCORPORATED

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• • •

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Repainting Transformers In the Field

E. A. ELGE
Transformer and Allied Product Divisions
General Electric Co., Pittsfield, Mass.

PROCEDURES are outlined to prepare corroded transformer tank surfaces for painting and refinishing. Because the factors influencing finish deterioration differ for outdoor (or indoor) and underground transformers, each will have its own recommended repainting procedure.

Surface Preparation

All loose paint, blisters, scale, and rust must be thoroughly removed, and where the condition of the tank is particularly bad, the paint is removed entirely.

Three practical methods of preparing the tank surface are sandblasting, wire brushing, and chemical removers.

Brushing, sandpapering, or scraping is desirable where only partial surface cleaning is necessary. The edges of the area should be beveled down by sandpapering.

Paint removers, such as strong solvents or alkalis, will soften paint and aid in removal. With the new synthetic baked finishes this type of paint removal becomes more difficult.

If alkali cleaners are used, the surface should be thoroughly rinsed with clean water. That operation should be followed by another rinse of clean water containing one gram of potassium dichromate per gallon to inhibit rust formation. The surface should then be allowed to dry thoroughly.

For removal of oil and dirt, weak solvents such as mineral spirits, turpentine substitutes or other petroleum thinners should be used. Strong solvents such as acetone, ketones, etc, should be avoided, as they will affect the otherwise good paint.

After cleaning by any of the above methods, the tanks should be painted as quickly as possible.

Method of Applying Paint

Three general methods of applying paint are brushing, flow method, and spray method.

From the standpoint of consumption of material, the spray method uses slightly more paint than the brush method, but the former is very much faster. Furthermore, a properly sprayed finish gives a much more uniform and less porous film than brushing. If any parts are not easily accessible, such as tubular tanks or radiators, they should be "flowed".

Number of Coats Required

Where the surface of a transformer tank has been abraded, or where there are only small spots which require attention, these places should be carefully cleaned and the bare metal should be primed with the proper priming material. This priming coat should be allowed to dry, and then a finish coat should be applied to the spots covered with primer.

It may be desirable to repaint the whole tank with a finish coat only. When this is done, the whole surface of the tank should be cleaned with a weak solvent and then carefully inspected for spots that are abraded, rusty, etc. These spots should be carefully cleaned, primed and dried prior to application of the finish coat.

Where the paint has been removed from the entire surface of the tank, one coat of priming paint should be applied over the entire surface, followed by one or more coats of finish paint.

Mineral spirits, turpentine substitutes or turpentine may be used for thinning the paints. Mineral spirits or turpentine substitutes are generally preferable since they are less expensive and in addition not only have fully as satisfactory characteristics for spraying but give better results than turpentine for flow mixtures.

For brush application the paints should be used as received without thinning. For spraying or flowing the paints should be thinned to the following viscosities as measured at 21 C with a Zahn No. 3 viscometer: Spraying, 14-17 sec; Flowing, 9-11 sec.

Repainting Outdoor Transformers

The paints used in the factory are recommended for use in service shops and in the field. They are readily applied by any one of the three methods—brushing, flowing and spraying.

The priming coat should have exceptional covering properties and it is desirable that the primer act cathodically on the steel to inhibit corrosion. While it should be flexible enough to expand and contract with the metal, it should dry to a very hard surface to be particularly effective in resisting damage by mechanical abrasion or chipping. (A melamine-glyptal primer can be used.) Allow the priming coat to air dry at least 8 hr before application of finish paint.

Some operators have finished transformer tanks with light-colored or metallic-base paints to decrease heat absorption on sunny days. The resultant reduction in transformer temperatures is negligible. Transformer finished with metallic-base paints will have a higher temperature when operaitng in the shade than if finished with a nonmetallic paint. Hence selection of a finish paint should be based on its durability and appearance only.

The finish coats should have extraordinarily good adhesion, toughness, flexibility and gloss retention. (A melamine-glyptal base paint is usually suitable). For repainting in the field, either one or two coats of the paint can be applied over the primer or over any paint which is still in good condition except from the standpoint of appearance. Allow approximately 8 hr to air-dry before applying a second coat of finish paint.

The paint used for the inside of oil-filled transformer tanks or the inside of oil-filled compartments such as used to house load-ratio-control should be recommended by the manufacturer. Paint used for these applications must be air-dried at least 72 hr at 70 F before coming into contact with oil. Primers must not be used on interior oil-exposed surfaces. Repainting of askarel-filled equipment should be limited to the external surfaces only.

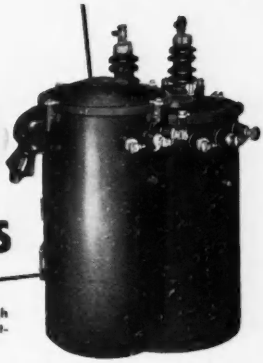
Repainting Underground Transformers

Dirt, mud, chemicals, etc, should be removed with clean water and oil should be removed by prescribed methods. The tank should then be dried and the loose paint removed.

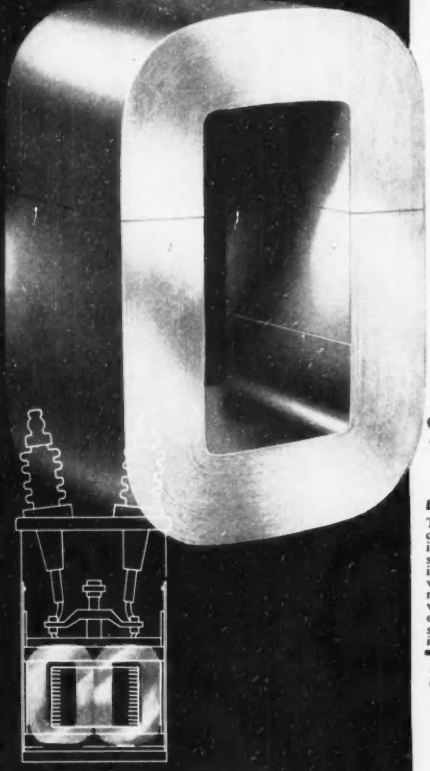
Priming and finish coats should have the same general characteristics described previously except that for underground use the paints should have a higher degree of flexibility and should be more acid resistant. (For such an application, a bakelite-tung oil paint could be used.) Eight hours should be allowed between each coat for air-drying.

Underground apparatus can be repainted by the flow method, the spray method, or by brushing. It has been found necessary in some cases to use a hot-air blower to dry the tanks thoroughly before painting when the painting is done in the manholes. Where speed is essential, a hot-air blower can also be utilized to reduce the drying time of the paint between coats and after applications of the final coat.

THE NEW MOLONEY HiperCore* DISTRIBUTION TRANSFORMERS



*Cores made of High Permeability, Oriented, Silicon Steel.

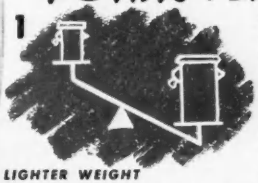


The new Moloney HiperCore Distribution Transformers incorporate advanced engineering practices and simplicity of construction, plus the usual Moloney high factor of safety in design. Cores are wound of high permeability, oriented, silicon steel having 30% to 35% greater flux carrying capacity than hot rolled steel.

HiperCore Transformers with wound cores, are lighter in weight and smaller in size than transformers having cores of non-oriented steel. They have greater short-time overload capacity and better voltage regulation. Simple construction and low winding temperature gradient result in trouble-free operation, longer life under all loading conditions.

4 STAR FEATURES

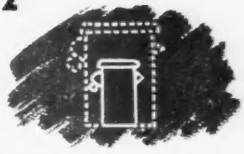
1



LIGHTER WEIGHT

The 30% to 35% higher flux carrying capacity of the oriented core steel used in HiperCore Transformers makes possible the use of smaller cores and windings, with consequent reductions in the weight of steel, copper, oil, and other materials. HiperCore Transformers weigh 15% to 30% less than transformers having cores made of hot rolled steel, making them easier to handle and install.

2



SMALLER SIZE

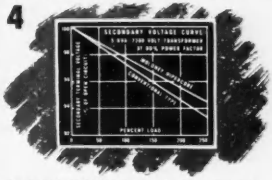
Since the higher flux carrying capacity of oriented steel permits the use of smaller cores and windings, smaller tanks can be used. Reductions in size range up to 30%. HiperCore Transformers take up less space on the pole, in the storeroom, and on the line truck.

3

GREATER SHORT-TIME OVERLOAD CAPACITY

Moloney HiperCore Transformers have improved short-time overload characteristics which provide better peak load performance and longer life. Reduced coil mass, achieved through use of oriented steel cores, together with the extensive use of cooling ducts, results in more rapid cooling of the windings and in a lower hottest-spot temperature gradient.

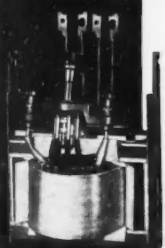
4



BETTER VOLTAGE REGULATION

The smaller cores of HiperCore Transformers make possible windings having lower impedance. Lower impedance provides lower internal voltage drop at all loads. This is especially important during peak load periods, since HiperCore Transformers can carry higher overloads than older types, at the same permissible regulation.

Above: After cores are wound, they are annealed, impregnated and then cut into pairs of U-shaped pieces. Two large U-shaped pieces are placed side by side, forming an inner and two outer core legs. Then the windings are placed into position to complete the magnetic circuits. A thermo-setting adhesive bonds the core faces together. Steel bands are used to obtain tight joints. Complete core-and-coil unit at right.



Write for BULLETIN H-303 describing the New Moloney HiperCore Transformers

MOLONEY ELECTRIC CO.

Transformers Exclusively Since 1896

FACTORIES AT ST. LOUIS 20, MO. & TORONTO, ONTARIO, CANADA

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GENERAL ELECTRIC
TO DRAMATIZE THE IMPORTANCE OF

THE LIGHT IN YOUR LIFE

"Nancy" and the Professor go in for air travel while he points out how lighting works for everyone.

Everyone should see "The Light in Your Life"

THE MOST IMPORTANT FILM G-E LAMPS HAS EVER PRODUCED!

PRESENTS A GREAT NEW FILM

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This eonchalant character is Professor J. Lumen Lightly, electrical wizard who shows "Nancy" the magic of lighting.

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Plan now to have all your personnel see "The Light in Your Life" soon. And if you haven't seen it yourself . . . contact your nearest General Electric Lamp Department office right away!

GENERAL ELECTRIC

Crossarm Vertical Assembly Carries Double Load Plus

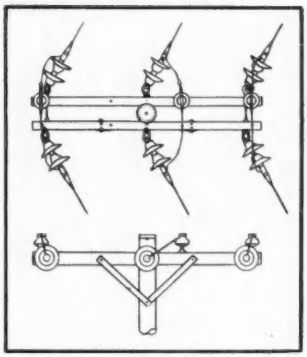


FIG 1—DEAD-END ASSEMBLY with conventional double crossarm

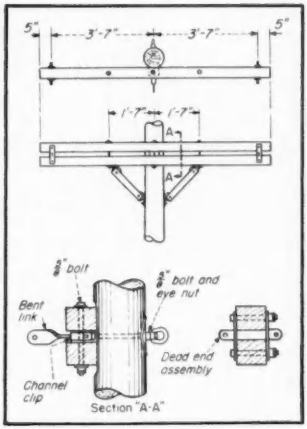


FIG 2—CROSSARMS rearranged to vertical assembly

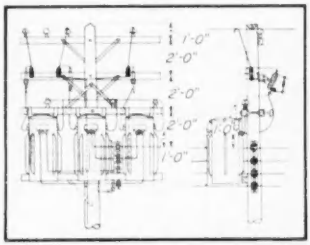


FIG 3 — TYPICAL TRANSFORMER mounting on one crossarm

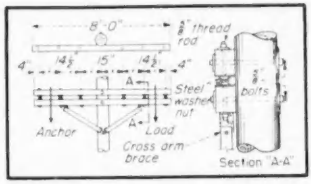


FIG 4 — VERTICALLY ARRANGED crossarms for transformer support

ULTIMATE LOAD on wood crossarms can be more than doubled by materials rearrangement from the conventional type double-arm assembly to a vertical placement over each other on one side of the pole. This result has been revealed by Hughes Brothers, Seward, Nebraska. An investigation of the two assemblies was made for (1) dead-ending of conductors on distribution systems and (2) supporting transformers in single-pole construction using the typical hook-over arm hangers. For four assemblies of $3\frac{1}{2}$ x $4\frac{1}{2}$ in. standard distribution arms, load and deflection data are listed in the accompanying table.

Fig 1 indicates the typical method of dead ending conductors using the conventional "space bolt" and eye-nut practice with crossarms installed vertically on each side of the pole.

Breaking tests, with loads applied similar to those which are induced by tension in the conductors, reveal the loads are not evenly distributed to the two arms and the one which is most rigidly supported will receive the major portion of the load. Consequently the double member does not increase materially the strength value over that of a single member.

Fig 2 shows a rearrangement of the wood members wherein the arms are placed both on one side of the pole and the load applied evenly between the two arms. A special plate washer serves as both connection to the pole and provides the method of attachment of the arms using the regular through-bolt holes.

The dead-end fixture is an assembly which provides, in addition to the attachment of the insulator, a vertical connection insuring the clamp being held in his position.

Fig 3 indicates the typical method of supporting 5 to 25-kv transformers using an application similar to that in Fig 1, which in turn places the load on one arm only of the double arms.

Fig 4 shows a rearrangement of the wood members wherein the arms are placed both on one side of the pole vertically over each other. Here two through-bolts are used through the pole and by placing standard space bolts in each of the six pin holes, the arms are held separated by the use of standard washer nuts back to back. Thus an effective truss is formed more than doubling the value of the two arms.

TEST DATA FOR FOUR CROSSARM ASSEMBLIES

FIG 1		FIG 2		FIG 3		FIG 4	
Load lb	Defl. in.	Load lb	Defl. in.	Load lb	Defl. in.	Load lb	Defl. in.
625	3/4	700	1/4	250	5/16	1200	1/8
1025	1 1/4	1150	3/8	500	15/16	2100	1/4
1475	1 7/8	1650	1/2	750	1 3/4	3000	7/16
2025	2 3/4	2600	7/8	1000	3	4000	1/2
2600	3 5/8	3500	15/16	1250	4 1/2	5000	9/16
		4500	1 3/8	1500	6	6000	5/8
		5000		1650	7 1/2	7000	1
						8000	1 1/4
						8600	Failure
						5000	Load Held

Air Axe Speeds Root Cutting

JACK GIBSON
Gustav Hirch Organization, Inc
Warren, Ohio

AN AXE HEAD driven by a standard air hammer cuts big tree roots easily and quickly for underground crews. The tool is also useful in clearing right of way.

The design shown is made by taking a broken air drill and sawing off a 24 in. length from the end that fits the air hammer. Two strap steel braces are welded to this shank. A

No Place for a Weakling

Have you ever asked this question—"How do you *know* the working strength of O-B suspension insulators?" The answer is simple—we know because *each one has proved its strength* by test.

As the picture shows, long strings are linked together and given an accurately-weighed pull by an air cylinder. This pull is in accordance with industry standards that specify a working strength of 40 percent of ultimate. O-B tests at 50 percent for added safety. O-B suspension units receive this test before going into the crate. There is no question about an occasional "weakling." It disappears right here!

Most of the insulators on your system, operating in normal tangent position, will never be called upon to deliver more than a fraction of their possible strength, but the exception—the long span or the heavily-worked deadend—can be built with confidence with insulators that have actually demonstrated the strength you need.

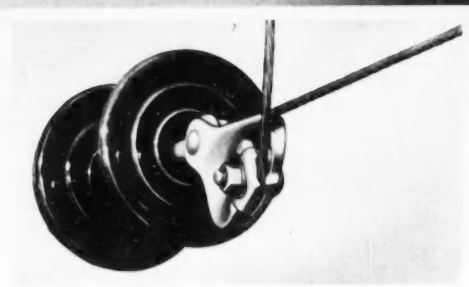
It is this element of confidence backed by realistic inspection methods that means so much to the habitual O-B user—confidence you can have by simply specifying "O-B" on your suspension insulator requirements.

Ohio Brass

MANSFIELD, OHIO, U. S. A.

HI-TENSION NEWS Junior

The Trick is to Do it Right!



It's no real trick to make a strain clamp that will hold a cable, but it is a trick to hold one and do it no damage. It's this know-how, bred of long experience in both low and high voltage applications, that makes O-B Universal Strain Clamps a wise investment for rural and urban distribution lines.

These clamps apply a snubbing action to produce their unusually high slip strength—better than 90 percent of the cable's ultimate. This is done without destructive crushing force applied by the clamp jaw which can rob the cable of its strength.

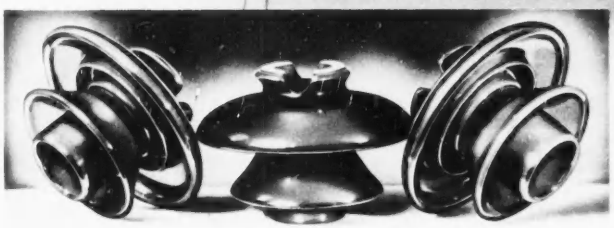
Jumper loops take a natural formation and do not necessitate cutting the conductor; thus eliminating the need for connectors in the power circuit at such points.

Since such loops require the conductor to cross itself, the danger of chafing and wear at this point is prevented by a generous offset, positively held apart by the shape of the clamp. Again, the conductor is protected from damage.

From a construction standpoint, strength of the various Universal Strain Clamps is sufficient to develop full ratings of all conductors which they will accommodate. Each clamp has a wide range of sizes, provided by a two-range keeper piece. Line crews find these clamps unusually easy to handle and install because of the absence of small, loose parts.

When you build your lines with O-B Universal Strain Clamps, you will save time and money during construction—and that's the last you'll ever hear from them! Put them on your specifications.

If you're buying pintype life—the answer is O-B



You can buy quite a lot of pintype insulator for three to five dollars. But, once the construction crew moves out, it may cost as much as five dollars just to send a man to *look at* that insulator, and this cost will mount to many times five dollars to dispatch a line crew to replace it. Your investment in insulation is by no means measured by its small purchase price.

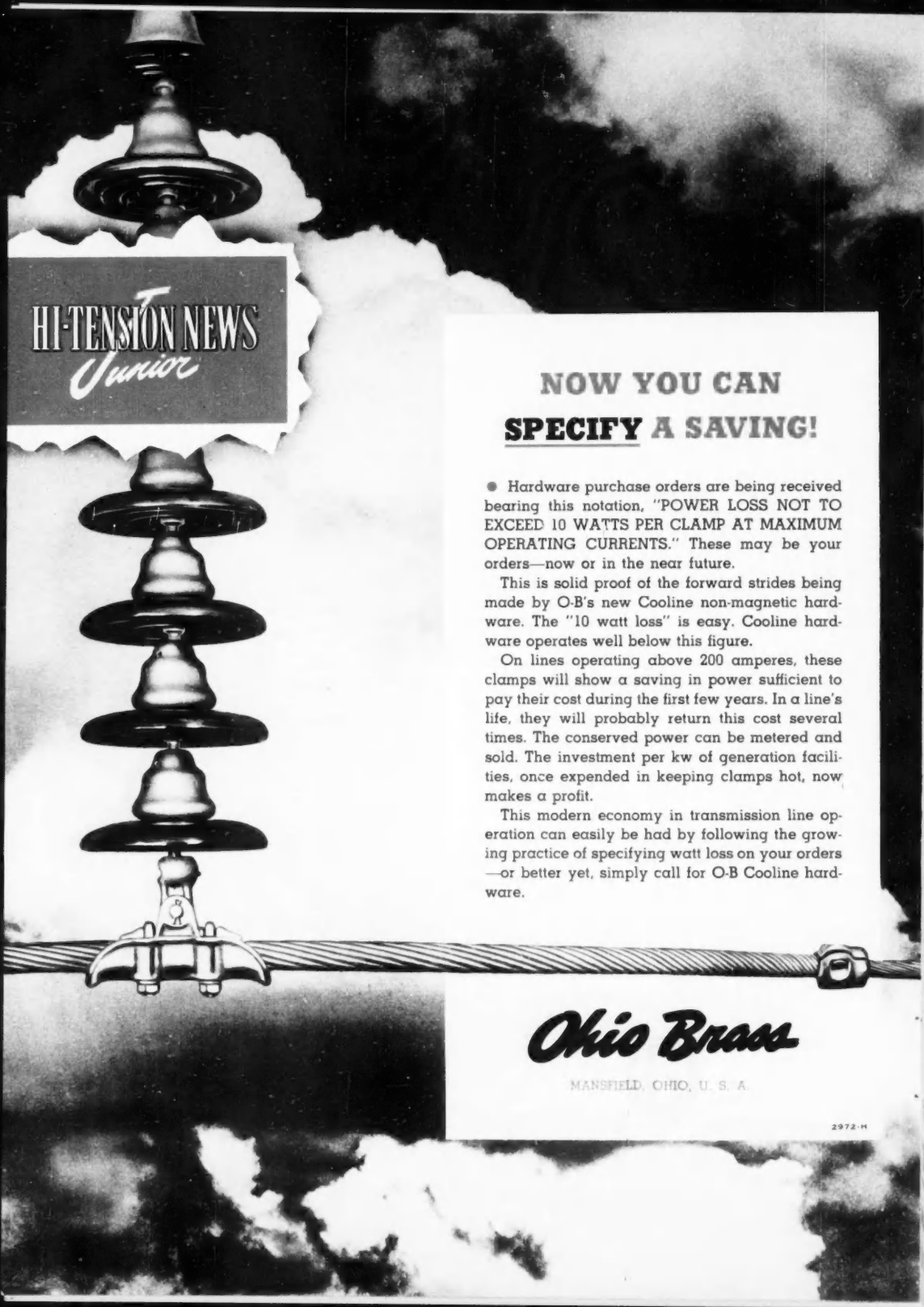
Most pintype insulators have adequate electrical characteristics, since the voltage under which they operate does not impose high duties. It is in the field of *mechanics* where such an insulator calls for critical design.

Extremes of heat and cold, occurring in the course of many seasons, or taking place in quick succession, impose mechanical strains on the porcelain which can be dealt with only by skillful engineering. No mere examination of an insulator will tell you how well or how thoroughly it has been considered from this standpoint. Yet, sound thermal design is strictly a matter of life and death in connection with a pintype insulator.

Records of O-B pintypes establish a fact that mere claims would never prove—these insulators have far outlived others that looked very much the same when new. This is no accident. It is the result of recognizing the primary problem in pintype insulator performance, and having the desire and capacity to whip that problem. If you buy insulators by mere external appearance, there's very little difference. If you're buying life, however, the answer is O-B!

Ohio Brass

MANSFIELD, OHIO, U. S. A.



NOW YOU CAN
SPECIFY A SAVING!

● Hardware purchase orders are being received bearing this notation, "POWER LOSS NOT TO EXCEED 10 WATTS PER CLAMP AT MAXIMUM OPERATING CURRENTS." These may be your orders—now or in the near future.

This is solid proof of the forward strides being made by O-B's new Cooline non-magnetic hardware. The "10 watt loss" is easy. Cooline hardware operates well below this figure.

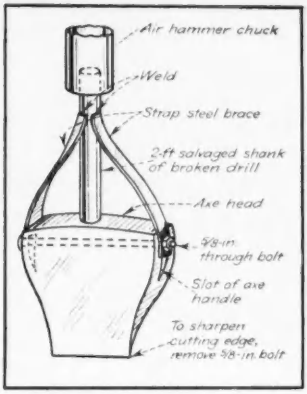
On lines operating above 200 amperes, these clamps will show a saving in power sufficient to pay their cost during the first few years. In a line's life, they will probably return this cost several times. The conserved power can be metered and sold. The investment per kw of generation facilities, once expended in keeping clamps hot, now makes a profit.

This modern economy in transmission line operation can easily be had by following the growing practice of specifying watt loss on your orders —or better yet, simply call for O-B Cooline hardware.

Ohio Brass

MANSFIELD, OHIO, U. S. A.

2972-H



AXE driven by air hammer speeds cutting tree roots and clearing right of way

bolt through holes at the bottom of the braces hold the shank snug on top of the axe head, as shown. When the axe gets dull, it can be sharpened by removing the through bolt.

Maintaining 110-Kv Transformers and OCBs

J. A. RAWLS
Supervisor

Electrical Equipment & Transmission
Virginia Electric & Power Co.
Richmond, Va.

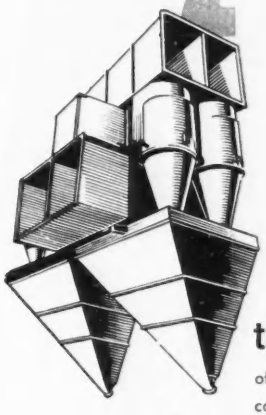
AFTER 30 years growth, about 600,000 kva in 110-kv transformers ranging in size from 100 to 40,000 kva are being systematically maintained in 45 stations of the Virginia Electric and Power Co. By 1953 the system will have 1,200,000 kva of 110-kv transformers, if present plans materialize.

110-Kv Transformers

Starting about 20 years ago: (1) 110-kv stations are inspected quarterly; (2) all oil going into 110-kv transformers is filtered through a centrifugal oil purifier and a 12-in. blotter press; and (3) oil is dielectric tested in the field by a portable tester. In general, transformer inspection consists of checking maximum temperature since last inspection, oil leaks, oil level, oil dielectric, condition of bushings, paint, relief dia-

From a paper presented before an Engineering and Operations Conference of the Southeastern Electric Exchange

Custom Tailored
fly-ash
COLLECTION



the agonizing trickle

of maintenance costs won't add up to a costly dollar-pool, if your fly-ash collection system is custom-engineered by Buell. The large-diameter cyclones won't interrupt your operation by clogging. Individual inlets to each cyclone insure even distribution of dust-laden gas. The utter simplicity of a Buell cyclone prevents costly operating complications. With all this, the patented van Tongeren 'shave-off' makes operating efficiency surprisingly high. The money-saving facts are all in the new 32-page catalog. Write: Buell Engineering Co., 70 Pine Street, Suite 4900, New York 5, N. Y.

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DUST COLLECTION

BLAW-KNOX

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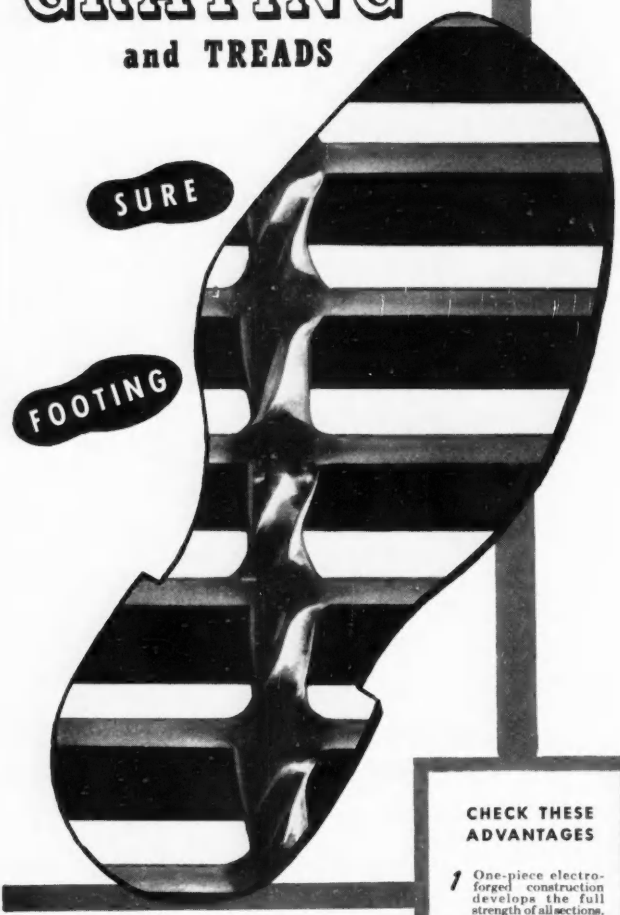
STEEL GRATING

and TREADS



CHECK THESE ADVANTAGES

1 One-piece electro-forged construction develops the full strength of all sections.

2 Maximum Open Area for light and ventilation.

3 Easy to Maintain . . . easy to paint thoroughly.

4 Self-Cleaning, no sharp angles to retain debris.

5 Safe footing at all times due to twisted cross bar.

BLAW-KNOX DIVISION

OF BLAW-KNOX COMPANY

2013 Farmers Bank Bldg., Pittsburgh 22, Pa.

• • • •

. . . So that you can have a "close-up" of Blaw-Knox Grating construction, write for a paperweight-size sample on your letterhead.

phragm, breather material and any other noticeable conditions.

In 1936 a power factor test set was leased, and later a second was leased. With these sets, defects are detected before they reach the danger point. All of the 110-kv transformers on the system were tested as soon as practicable after leasing the power factor test set. Several transformers were found which needed drying out. By this test, bad oil was detected that would not show up on the dielectric test. During the past 12 years, 110-kv transformers have received more thorough maintenance than ever before. Each unit is power factor tested every two to five years. Unless the units are moved in the meanwhile, they are regasketed, cores and coils are pulled, etc, about every ten years.

Recently, a turn-ratio meter has been used to check the ratio on all units along with the power factor test. Also, now a Ducter is used to try to detect high resistance in contacts of ratio adjusters. Because of contact difficulty, several no-load ratio adjusters have been replaced.

New transformers are bought on the basis of specified power factor limits at the factory. When new units are received, they are tested for power factor before being placed in service. This checks their condition and establishes a base line power factor for the unit. The transformers also are checked for proper ratio on each setting of the no-load ratio adjuster, and internally for such things as loose bolts and contacts.

All new 110-kv conservator and free breathing transformers are supplied with breathers containing dehydrating material. Such breathers also are being installed on older transformers. Reducing the moisture that gets into a unit decreases maintenance and increases its life.

110-kv Oil Circuit Breakers

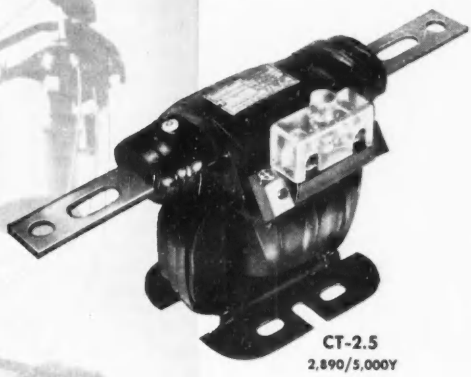
For many years, the same schedule for inspecting and testing of oil was used for 110-kv circuit breakers as for the transformers. When the oil showed signs of carbon, the tanks were drained, contacts checked, and the oil filtered and replaced.

But as the system grew, carbon deposits increased, and it was necessary to inspect the oil breakers internally more often. As a result, internal inspections now are based on number and magnitude of faults interrupted.

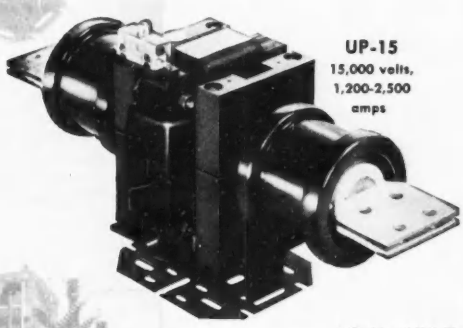
After leasing the power factor test

NEW

TWO NEW CURRENT TRANSFORMERS
for dependable accuracy at high and low ratings



CT-2.5
2,890/5,000Y volts,
10-800 amps



UP-15
15,000 volts,
1,200-2,500 amps

TYPE CT-2.5

This new addition to the well-known Westinghouse CT line of instrument transformers is designed for low voltages. It provides high accuracy and 45-kv impulse strength for metering and relaying applications.

TYPE UP-15

The new UP-15 provides exacting accuracy for metering and relaying applications at higher ratings. Wet process porcelain insulation surrounding the heavy, bar-type primary guarantees a more consistent margin of strength.

Westinghouse indoor current transformers, the most complete line in the industry, are backed by the type of research and development that assure top-quality performance. For complete information, write your nearby Westinghouse office or Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-70520

CHECK THESE OUTSTANDING FEATURES:

- 0.3 class accuracy for burdens B-0.1 through B-0.5.
- Hipersil* core steel for light weight, small size and greater metering and relaying accuracy.
- Transparent terminal blocks to place secondary connections within easy observation.
- Automatic short-circuiting devices to protect personnel from induced high open-circuit voltages.
- EEI-NEMA standard mounting dimensions.

*Registered U.S. Trademark

Westinghouse
PLANTS IN 25 CITIES... OFFICES EVERYWHERE

YOU CAN BE SURE IF IT'S Westinghouse

He's a chip off the old block, all right...the same "radiant glow" appearance and fine **precision-planned** lighting performance that's already made the original **Guthlite*** so successful. In fact, "JR." is the livin' image of his daddy except that he sports a "junior" price tag and has no "Jacknife" Hinge.

Instead, you merely release two little hooks on **either** side and the louver assembly swings down for easy relamping and cleaning.

Guthlite* JR. comes in both 2-40W and 2-85W sizes. For complete details, request our new Pocket Catalog **46A-H**. Where you need a **proved** performer at a popular price, you can really cash in on this husky, handsome youngster ...take it from

Guth LIGHTING

YOUR TEAMMATE IN *precision-planned* LIGHTING

THE EDWIN F. GUTH COMPANY / ST. LOUIS 3, MISSOURI

Leaders in Lighting Since 1902

*® 720

set in 1936, all of the 110-kv circuit breakers were tested and many of them were in bad condition. Besides deteriorated bushings, the internal fibrous material was very wet. On going into the tanks and checking the breakers, carbon tracks started from conductor to ground on the lift rods, guide members, etc, were found. The fibrous material was removed, dried out in an oven, retreated and placed back in the breakers. A Ducter is used to check for high resistance in the primary circuit. Since 1940, a Cincinnati analyzer is used to give a graphic indication of every point in the opening and closing cycle of the breaker.

With the power factor test set, dielectric oil test, Cincinnati analyzer and Ducter, breakers do not have to be opened for maintenance nearly as often as they did before using these tests. A record is still kept of the faults cleared; and when a breaker reaches a predetermined number, tests are made and the results determine whether or not to open it. As a result of proper testing and adjusting, approximately 50 operations on breakers under fault conditions have been obtained. Previously, about 20 was considered to be the limit.

Oil Storage Tanks

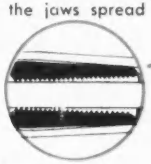
Oil storage tanks are being installed at stations were 110-kv breakers are used. Thus, all three tanks of a breaker can be drained and inspected in one day, instead of requiring two or more days, as previously. The 6,000 gallon oil tanks have two 3,000 gallon sections. The oil from a breaker is pumped into one 3,000 gallon section and then filtered from this section to the other section with the centrifuge filter while other men are inspecting and adjusting the breaker. When all adjustments are made on the breaker, the clean oil is pumped back into the breaker tanks.

After experiencing some mechanism troubles as well as broken lift rods in 110-kv breakers, a special quarterly inspection was given each 110-kv breaker. This inspection consists of tripping each breaker by relays to check the control circuit. When the breaker is tripped and closed, a capable electrician has the mechanism cabinet open and stands near the control where he can see it operate and hear any unusual noise in the breaker. This inspection has proved very helpful and is being continued.

Here's Why FARGO Automatic Line Splices Hold Securely...

The Fargo-Designed "One Piece" Jaw Is Accurately Machined from Solid Bar Stock!

With FARGO AUTOMATIC LINE SPLICES — it is this "one-piece" jaw that gives the first and all important grip before normal tension is applied. When the wire is inserted the jaws spread slightly — like this . . .



As the "come-alongs" are released the tip of the jaw closes first (See Fig. 1), and due to the "one-piece" construction, the back teeth bite the conductor with a force of approximately a 3 to 1 lever. Further tension "sets" the jaws on the conductors (See Fig. 2), and final tension (See Fig. 3), completes the grip — so it can't let go! The "one-piece" construction has another big advantage, too — the jaws can not get out of alignment!

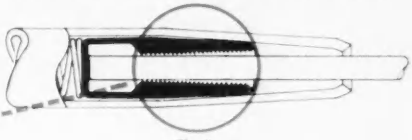


Fig. 1

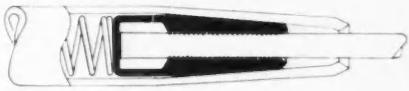


Fig. 2

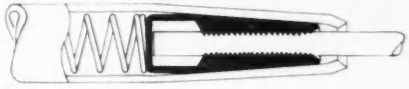


Fig. 3

Available in sizes from #8 to 350 MCM

ENGINEERS LIKE THEM — BECAUSE . . .

(1) All parts are equal to or better than copper in "weather-ability."
(2) They make a permanently low resistance connection.
(3) The connection is as strong as the conductor itself.
(4) The over-all cost of an installed Fargo Splice is low.

LINEMEN LIKE THEM — BECAUSE . . .

(1) No extra tools are needed to install them.
(2) They are safe to use when working in cramped "danger zones."
(3) Sag guide helps linemen to properly sag lines.
(4) Large safety zone to accommodate burred ends of wire.

ELECTRONS LIKE THEM, TOO

"— the over-all resistance of splice plus contacts is less than the equivalent lengths of conductor —."

FARGO

Distributed by
LINE MATERIAL COMPANY
Milwaukee, Wisconsin

Manufactured by
FARGO MFG. COMPANY, INC.
Poughkeepsie, N. Y.

LM

"We Were Able To *Increase* The *Load* On A Bus Duct Without Changing Fuse Holders"

"In May, 1945, we moved considerable electrical equipment from a plant in Buffalo to a new plant at Niagara Falls. Several runs of bus duct were moved and installed with some load added.

"The fusible swing-out plugs in the bus duct system were 60 ampere capacity. It was soon found that 60 ampere ordinary fuses would not handle the starting surges or other temporary overloads caused by the additional equipment on the circuit.

"Our Electrical Engineer suggested Fusetron dual-element fuses. The troublesome, needless blows were stopped immediately.

"The Fusetron fuses permitted all machines to be kept in operation without any change in the size of the fuse holders."

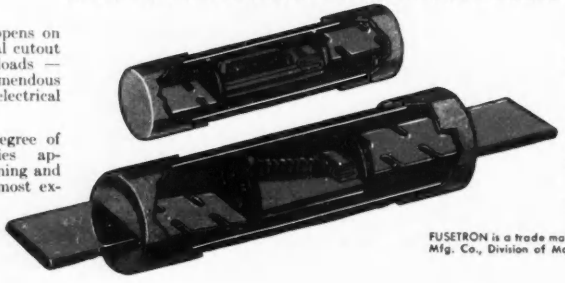
Ferguson Electric Construction Co.,
Buffalo, N. Y.
C. P. Wachtel, Vice President

Simply by Installing

Facts About FUSETRON Dual-Element FUSES

The fuse link element opens on short-circuit — the thermal cutout element protects on overloads — the result, a fuse with tremendous time-lag and much less electrical resistance.

They have the same degree of Underwriters' Laboratories approval for both motor-running and circuit protection as the most expensive devices made.



Made to the same dimensions as ordinary fuses — fit all standard fuse holders.

Obtainable in all sizes from 1/10 to 600 ampere, both 250 and 600 volt types. Also in plug types for 125 volt circuits.

Their cost is surprisingly low.

FUSETRON is a trade mark of the Bussmann Mfg. Co., Division of McGraw Electric Co.

Fusetron DUAL-ELEMENT Fuses

with their

10 Point Protection

1. Protect against short-circuits.
2. Protect against needless blows caused by harmless overloads.
3. Protect against needless blows caused by excessive heating — lesser resistance results in cooler operation.
4. Provide thermal protection — for panels and switches against damage from heating due to poor contact.
5. Protect motors against burnout from overloading.
6. Protect motors against burnout due to single phasing.
7. Give DOUBLE burnout protection to large motors — without extra cost.
8. Make protection of small motors simple and inexpensive.
9. Protect against waste of space and money — permit use of proper size switches and panels.
10. Protect coils, transformers and solenoids against burnout.

Stop Wasting Time and Money —

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

FUSETRON Dual-Element Fuses Give ALL-PURPOSE PROTECTION

One needless shutdown — or one lost motor — or one destroyed switch or panel — may cost you far more than replacing every ordinary fuse with a FUSETRON Dual-Element fuse.

Don't risk such losses — protect yourself by installing a FUSETRON Dual-Element fuse in every set of fuse clips throughout the entire electrical system.

Bussmann Mfg. Co., University at Jefferson
St. Louis 7, Mo. (Division McGraw Electric Co.)

Please send me complete facts about Fusetron Dual-Element Fuses.

Name _____

Title _____

Company _____

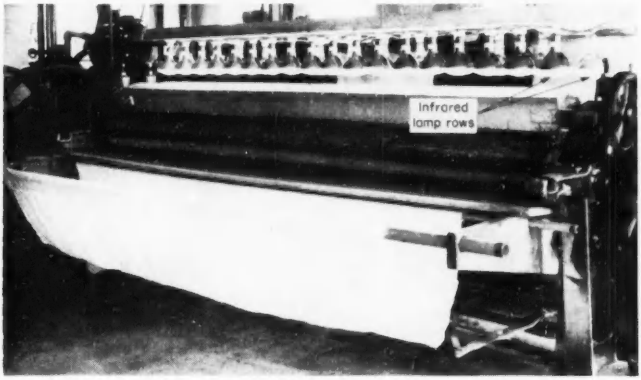
Address _____

City & Zone _____ *State* _____ 449

LOAD BUILDING

Commercial Ironing Speed Doubled by Infrared Units

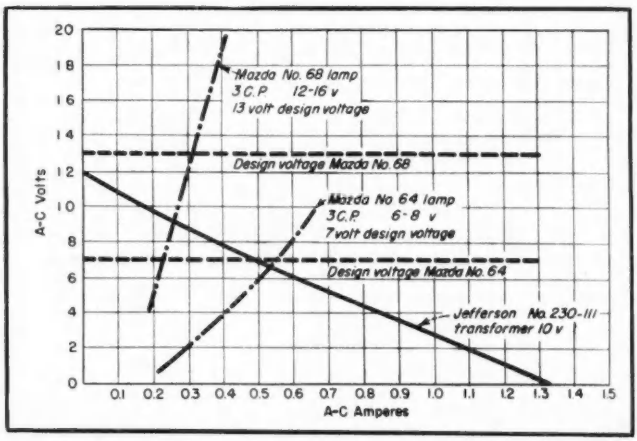
AT AN HOURLY COST of but 12¢ for energy consumed by 36 infrared lamps supplementing steam heat in an ironer 9 ft. wide, production was doubled. Ross O'Laughlin's Laundry, Inc, Meriden, Conn., would otherwise have had to purchase a new mangle. The machine's capacity was exceeded until the lamps were installed. Two rows of 125-w R-40 lamps were provided to heat the rolls, serving to supplement the heat produced by the steam furnished at 80 psi to the unit's steam chest. The front row has 18 lamps mounted on 6-in. centers with the lamps 4 in. above the rolls. The rear row has 12 lamps on 9-in. centers which are mounted about 12 in. above the work.



TWO-ROLL IRONER equipped with 3.75 kw of supplementary heating gives better finish with one pass than was obtained formerly with two passes

The switch controlling the ironer motor also governs the infrared lamp circuit. This prevents the lamps from being turned on unless the rolls are rotating. Every variety of home laundry can be handled efficiently on the ironer. The speed of the ironing was doubled by eliminating one of the two passes of work through the rolls.

House-Number Lamps Matched to Bell Transformer



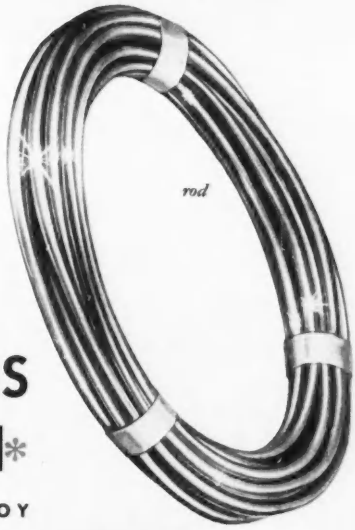
TYPICAL COMBINATION of transformer and lamp characteristic curves used by Sacramento Municipal Utility District in compiling guide for matching bell transformers and house number lamps. Customers can be assured adequate light with fewer burnouts as a result of use of the guide by contractors and suppliers

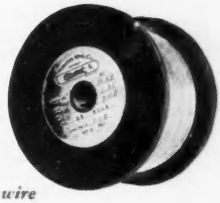
H. R. FITCH
Equipment Testing Engineer
Sacramento Municipal Utility District

SERVICES OUTSIDE the usual range of utility activities may often contribute materially to customer satisfaction. An example of such a service is a recent investigation by the Sacramento Municipal Utility District of the performance of small transformers.

More and more doorbell transformers are being used to supply lighted house numbers. Their steep voltage-load characteristic makes it difficult to predict performance at any load but the nameplate rating. Complaints of excessive burnouts or too-dim operation of lamps can be reduced by a guide for selecting proper lamp ratings for the many types of transformers available.

The Utility District developed such





HOSKINS
Chromel*
RESISTANCE ALLOY

. . . basic element of electrical heating

Here's the stuff directly responsible for today's widespread use of electric heat. It's Hoskins CHROMEL . . . the *original* nickel-chromium resistance alloy that *first* made electrical heating practical way back in 1906. Ductile, durable, hard-to-burn out, it possesses close-to-constant "hot" resistance between 700° and 2000° F. . . . delivers full-rated power throughout its long and useful life. And it's produced to a uniform tolerance of resistance as wire, ribbon, or rod to meet the requirements of a wide range of domestic and industrial applications. So if you're concerned with electric heat . . . from a load-building point of view, as a manufacturer of heating devices, or as a user of electric heat in your manufacturing processes . . . you'll do well to get acquainted with Hoskins CHROMEL. Complete technical information is contained in our Catalog M-1 . . . want a copy?

*

HOSKINS MANUFACTURING COMPANY
4445 LAWTON AVE. • DETROIT 8, MICHIGAN

Heating Element Alloys ★ Heat Resistant Alloys ★ Thermocouple Alloys ★ Spark Plug Electrode Wire ★ Special Alloys of Nickel ★ Electric Heat Treating and Laboratory Furnaces

Chromel® nickel-chromium wire

a guide by testing transformers sold and used in the Sacramento area. Voltage-load characteristics of transformers were measured and plotted. Operating currents of standard lamps of various voltages were also plotted. By superimposing lamp and transformer curves plotted with the same scales, performance of any combination could be predicted within close limits.

End result of the tests was a chart for the guidance of contractors, suppliers and others in selecting lamps and transformers. Customers are thereby assured of satisfactory performance from properly matched components.

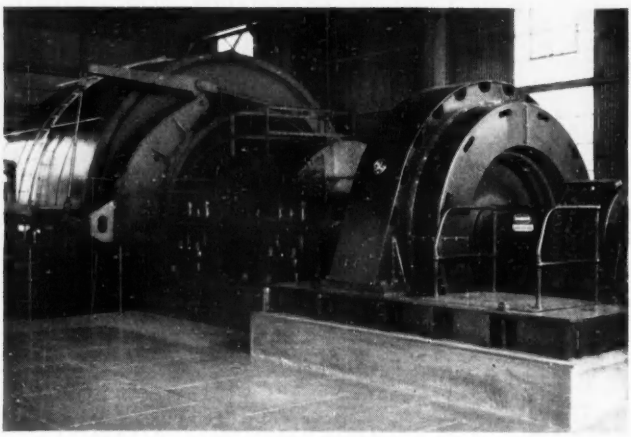
Electric Heat Guards Rare Birds

General Electric Co Photo

THE ACCOMPANYING PICTURE illustrates the fact that, until you discover them, "you never know" the special ways in which electric heat can be applied. The bird paying such interested attention to the explanation of the electrical connection by R. H. Gibson is a Vulturene Guinea from Africa.

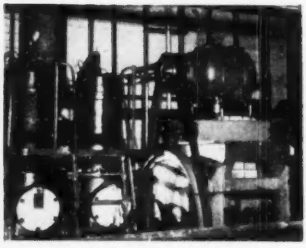
Naturally he is interested, because it was the soil heating cable buried in the sand of his pen that saved him and his wife from perishing in California's cold spell last winter. Cable in 66 other pens guarded the lives of other delicate members of the flock of 4,000 rare birds on the ranch of Mr. Gibson near St. Helena. Although the temperature dropped to 19 F last winter, the soil heating cable worked so effectively that not one bird was lost from the cold.

Ore Hoists Require Huge Motors

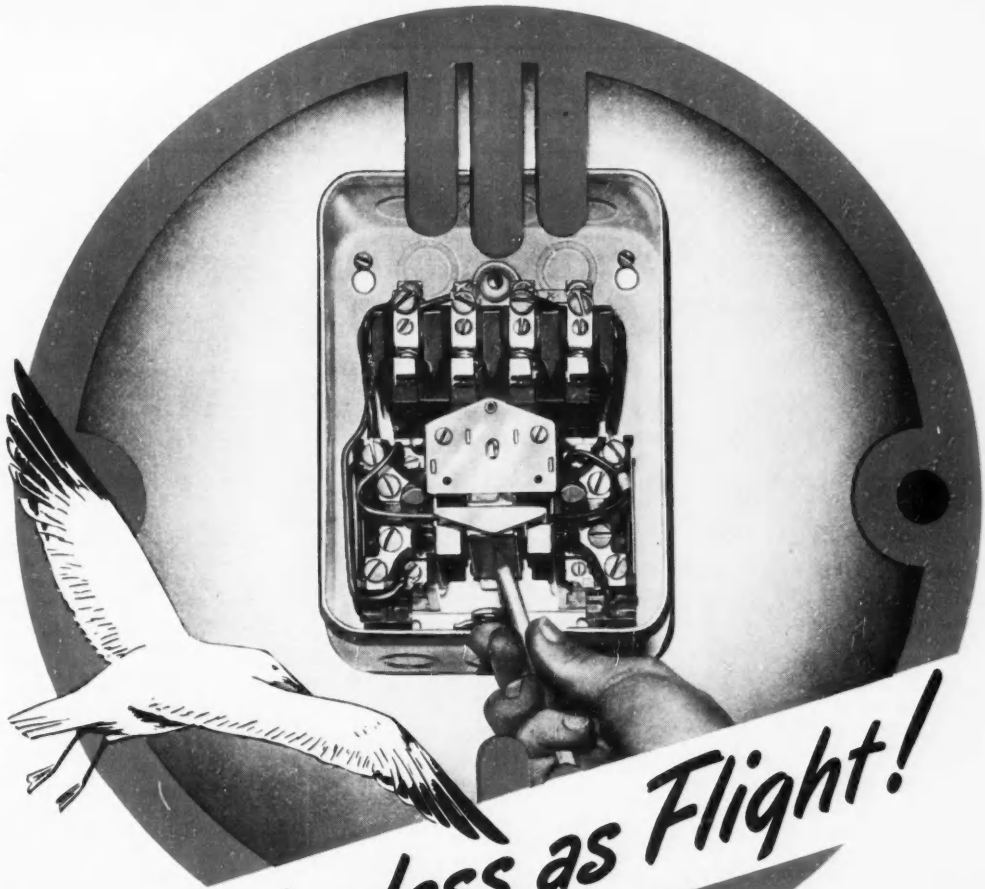


EIGHT BIG ELECTRICALLY DRIVEN HOISTS are used in the ore-mining district of the Tennessee Coal, Iron and Railroad Co, Fairfield, Ala. Motors driving the hoists range from 1,800 to 3,500 hp. Haulages vary from a mile to 7,000 ft. Rope speed ranges from 2,500 to 4,000 fpm. The 3,500-hp hoist shown is at Wenonah Ore Mine No. 7 and is believed to provide the fastest slope haulage in the world. Vertical depth of loading centers is about 1,400 ft

Electric Drive Belted to Replace Engine



LOW COST substitution of electric for oil engine drive for a refrigeration compressor was accomplished as shown in this picture. The scheme was suggested by the industrial sales department of the Mississippi Power & Light Co to a customer, the Coldwater Dairy Products Co, Coldwater, Miss. Pistons and connecting rods were removed from the Diesel engine and the motor belted to the flywheel. The motor is spring mounted on an I-beam frame straddling the shaft between the engine and the compressor. Conventional installation of the motor would have required addition of a pulley stub shaft and an outboard bearing to the compressor at a considerably greater cost



Frictionless as Flight!

Only Federal Noark Motor Starters have free action . . .
the one moving unit floats on ball bearings

YOU DON'T SEE the ball bearings, but push up that moving unit and you *know* they're there. Only a featherlight touch is needed! And only Federal Noark Motor Starters give you that floating ball bearing action—with consequent longer and trouble-free service life.

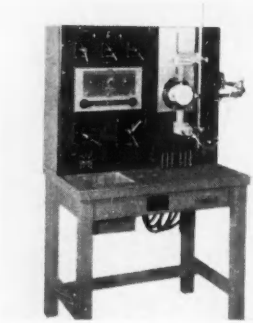
But chalk up too, these additional advantages of Federal Starters! Their overload relays allow you the choice of automatic or manual reset by merely turning a knob. Coils are replaced in a matter of seconds. All parts are readily accessible from the front.

Order Federal Noark Motor Starters from your Federal Distributor and save time, effort and money. And write us for free copies of the "Federalog" and "Simplified Motor Control" giving full descriptions. Federal Electric Products Company, 50 Paris St., Newark 5, N. J.

FEDERAL NOARK
MOTOR STARTERS

Complete line of Federal Electric Products includes Motor Controls, Safety Switches, Service Equipment, Circuit Breakers, Panelboards, Switchboards, Control Centers, Bus Duct ★ Sales offices in principal cities.

NEW EQUIPMENT



Meter Tester

DESIGNED for all types of watthour meters, a table model meter tester has been developed by Notnac Mfg Co, 1410 2nd St. S. W., Canton, Ohio. It is equipped with the latest model photoelectric tester.

Features of the unit include quick and positive locking of the positioning arms carrying the photocell and two hinged rear doors for convenient resistor adjustment.

•

Hydraulic Dynamometer

ACCURATE load-testing of a wide range of motors is possible with hydraulic dynamometers built to order by Wagner Electric Corp, 6488 Plymouth Ave, St. Louis 14, Mo. With this device such tests as idle, pull-in, pull-up, full-load and locked may be made.

Foot-pounds of torque are read directly from the gage furnished with the dynamometer. Assemblies are available in 30 to 300-ft-lb capacities and can accommodate ½ to 2⅞-in. motor shafts.

•

Pole Line Anchor

TO PREVENT under-cutting of the hole when expanding and to minimize earth resistance to expansion, earth-expanding pole line anchors are available from Oliver Iron and Steel Corp, Pittsburgh, Pa. Interlocking ridges on the blades and housing plates prevent a

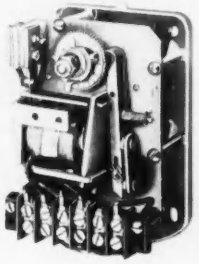
twisting action and equalize holding power distribution.

According to the manufacturer, the retainer nut on the bottom of the housing enables anchors to be salvaged easily or permits the rod to be safely buried in case of abandonment. The anchor is available in six sizes, including two and four-blade styles, with ratings from 3,000 to 17,000 lb.

•

Delay Relay

FOR USE in industrial control circuits where timed closing or opening of electrical circuits is desired, three basic types of the Timoflex delay relay are offered by Eagle Signal Corp, Moline, Ill. One type operates when the pilot switch closes, the second when the switch opens and a third when a push button is closed momentarily.



Timing scales include 55-sec and 5½, 27½ and 55-min ratings. Timers are available for operation on 110 and 220-v, 25, 50 and 60-cycle supplies. Current ratings are 10 amp at 110 v and 5 amp at 220 v. Each timer is provided with removable bakelite cover.

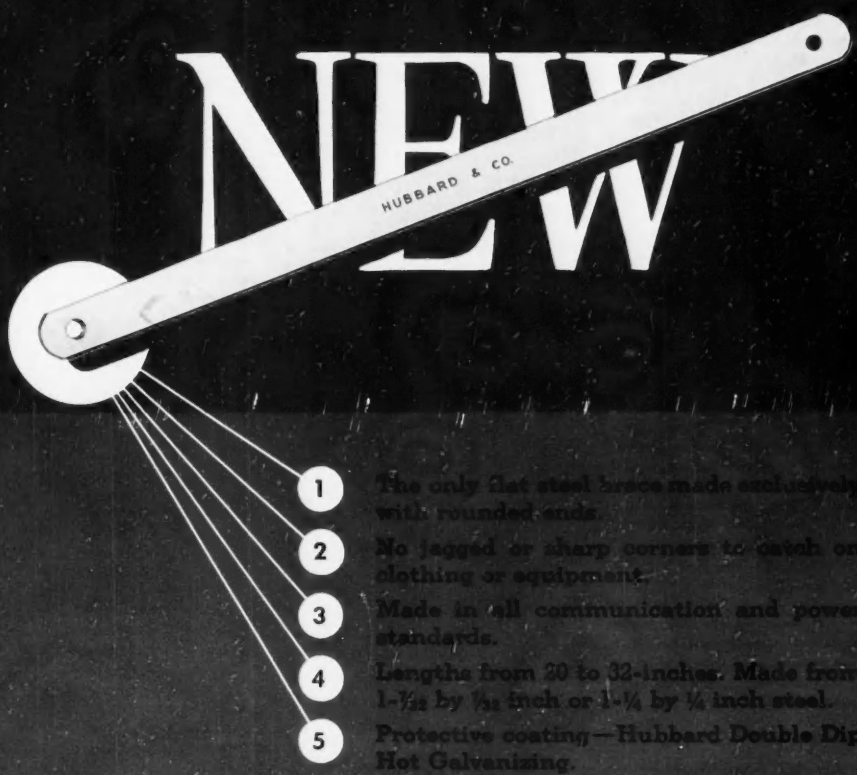
•

Combination Meter Socket

FOR FARM WIRING a combination weather-tight, tamperproof meter socket and outdoor service control is produced by Heinemann Electric Co, Trenton, N. J. The entire unit is rust-proofed and finished in baked gray enamel. The company advises that the nipple cannot work loose to allow entrance of moisture.

Enclosure and meter socket may be sealed by the power company; the cover over the circuit breaker may be locked by the customer. One or two magnetic circuit breakers are contained in the enclosure to protect equipment or transformer.

HUBBARD round end crossarm braces are NEW



1. The only flat steel brace made exclusively with rounded ends.
2. No jagged or sharp corners to catch on clothing or equipment.
3. Made in all communication and power standards.
4. Lengths from 20 to 32-inches. Made from 1-7/32 by 1/32 inch or 1-1/4 by 1/4 inch steel.
5. Protective coating—Hubbard Double Dip Hot Galvanizing.

Hubbard and Company has pioneered an entirely New trend in flat steel crossarm brace production. Under the New procedure, all braces now have rounded ends. This New trend has achieved a three-fold purpose; easier handling, greater safety and neater appearance. Accidents involving lost time are reduced in number by the elimination of sharp corners. Hubbard Round End Crossarm Braces are preferred by the Linemen—the men who "Hang the Load on Hubbard Hardware."

HUBBARD AND COMPANY

PITTSBURGH
CHICAGO

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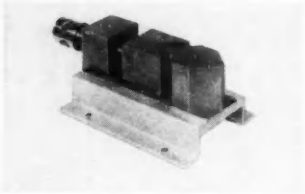
HANG THE LOAD ON HUBBARD HARDWARE



Bus Bar Bender

HAVING the capacity to bend bus bar up to 4 in. wide and ¼ in. thick to 90-deg angles, a portable bus bar bender is manufactured by Flexo Machines Co, 465 N. Aberdeen St, Chicago 22, Ill.

The unit measures 18½ in. overall and weighs 110 lb, thus being adaptable for use in the shop or field.

•

Fluorescent Luminaire

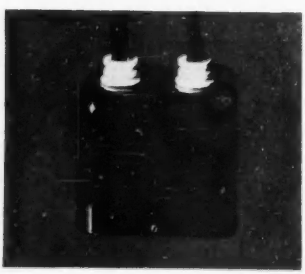
FEATURING a hinged construction which permits louvers to be opened to either side, or removed altogether, the fluorescent Guthlite, Jr. is offered by The Edwin F. Guth Co, 2615 Washington Ave, St. Louis 3, Mo. Side and spill lighting, accomplished without glass or plastic panels, is said to give this fixture a radiant glow.

The Guthlite, Jr. is wired for 110-125-v, 60-cycle service; has high power factor ballasts; can accommodate two 40 or 85-w lamps; and is available for individual or continuous row, flush or suspended mounting.

•

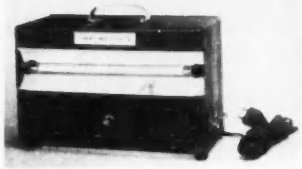
Display Sign Transformer

FOR COUNTER SIGNS, window displays and decorative neon signs, a portable transformer has been designed by General Electric Co's Specialty Transformer and Ballast Divisions, Schenectady 5, N. Y.



Compound-filled to assure quiet operation, the unit is available in one universal rating for all applications to operate and support up to 17 ft of 15-mm neon tubing. Spring-contact electrode receptacles facilitate the changing of signs.

•

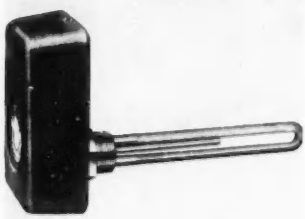


Emergency Light

AUTOMATIC, standby fluorescent lighting is provided by The Light Watchman emergency light manufactured by Chatham Products Co, 15 E. Runyon St, Newark 5, N. J. Actuated by interruption of the regular power supply, this unit will provide about ten hours of emergency service.

Powered by standard dry cell batteries, the light uses a standard Mazda lamp and plugs into any 115-v a-c supply. The carrying handle permits use as a portable hand light.

•



Water Heater Units

SCREW-IN TYPE electric water heater units with built-in thermostatic control, designed for conversion of fuel-fired hot water tanks, are announced by Edwin L. Wiegand Co, 7513 Thomas Blvd, Pittsburgh 8, Pa.

Heating element is a Chromalox copper-sheathed, enclosed type tubular heater. Thermostat controls water temperature between 100 and 170 F. Identified as Type ARTM, the heater is available for 118 or 236-v service at power levels of 750, 1,000, 1,250 and 1,500 w. Units may be used singly or doubly in tanks up to 80-gal capacity.

Heater-Speaker

TO EXTEND the season for drive-in theaters, a combination heater-speaker is manufactured by Theatrecraft Mfg Co, Cleveland, Ohio. It is reported that the heater will maintain a comfortable temperature in the car even in relatively cold weather.

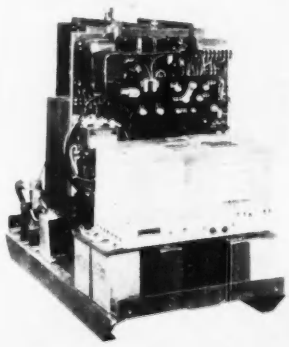
The unit contains a GE 250-w tubular heater and a GE 5¼-in. speaker with metal base voice coil to assure efficient service in all weather. The heater may be disconnected in warm weather without interrupting speaker operation.

•

Interference-Free Welder

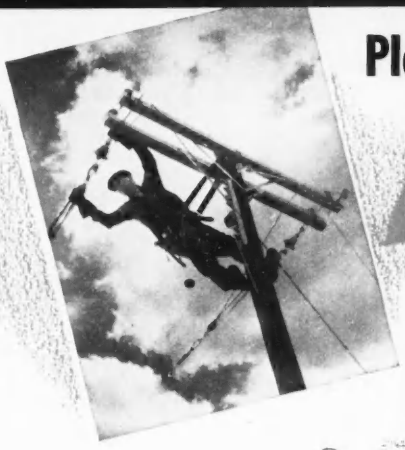
HIGH FREQUENCY, inert-gas-arc welders that do not interfere with radio or video reception are now in production, according to National Cylinder Gas Co, 840 N. Michigan Ave, Chicago 11, Ill. They are used to weld such metals as magnesium, aluminum, copper and stainless and light gauge steels.

The manufacturer advises that the units will maintain the assigned frequency of 27,120 kc regardless of weather or working conditions. Employ-

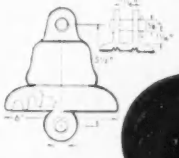


Planning New Distribution Lines?

PUT IT UP TO PINCO!



Putting up a Distribution Line is no problem when you "Put it up to Pinco" . . . because Pinco has everything you need —Insulators . . . Line Hardware . . . Guy Strains. Pinco makes them all and makes them good, as thousands of miles of such lines can prove. Engineered and built to distribution line requirements, Pinco products are not only RIGHT *for* the Job but RIGHT *on* the Job . . . for YOU—*Always!*



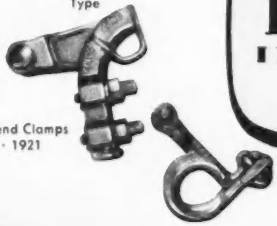
No. 1510
Pinco Suspension
Type

No. 1044
Pinco Pin
Type

No. 63
Pinco Pin
Type

PINCO
INSULATORS

Pinco Strain or Dead-end Clamps
Nos. 4038 · 4050 · 1921



Write today for your copy of the NEW 1949 PINCO CATALOG . . . the complete handbook for all who specify or buy porcelain insulators and line hardware. The coupon will bring a copy to your desk. Write for it today!

Pinco Guy Strains
Nos. 289 · 506 · 504 · 502

No. 223
Pinco Pin
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Suspension Insulators . . . Switch and Bus Insulators . . . Distribution Clamps Distribution Pin Types and Guy Strains . . . Transmission Line Fittings . . . Tree Insulators . . . Transformer and Circuit Breaker Bushings . . . One Piece and Multi-part High Voltage Pin Types . . . Suspension and Strain Clamps . . . Indoor Bus Support Porcelain . . . Lightning Arrester Porcelain.

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PRE • TROUBLE-SHOOTERS

BEFORE a Wheeler Ballast is completely assembled, all components are subjected to rigid inspection and test. Before the assembly is vacuum-impregnated with varnish, baked, "canned" and potted, each part is checked and re-checked for quality and performance, to assure absolute performance of the finished product.

A Wheeler Ballast must pass many of these exacting tests before it's given the Wheeler stamp of approval. As a result of this careful manufacturing procedure, Wheeler Ballasts are sold to the electrical industry with complete assurance that users will receive top performance and full satisfaction from each unit.

WHEELER BRICK TYPE BALLASTS
Available for the operation of two lamps in the following ratings: 40 watt, 118 volt, 60 cycle; certified by Electrical Testing Laboratories, Inc. Also for 220 volt, 50 or 60 cycle. All U. L. Approved.

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THE WHEELER INSULATED WIRE CO., INC.

SERVICE QUALITY WHEELER DEPENDABILITY

DIVISION OF THE SPERRY CORPORATION
1304 EAST AURORA STREET
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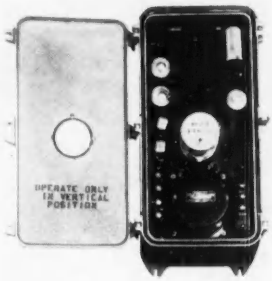
MAGNET WIRE • COILS • COMMUNICATIONS EQUIPMENT

ing a full-wave, self-rectifying oscillator (single tube) and a specially designed "tuned" torch, Sureweld Gasarc welders are produced in capacities ranging from 150 to 750 amp and are approved by FCC.

•



Industrial Integrator

PROVIDING MEANS for simple and effective integration of unidirectional potentials or currents with respect to time, an industrial integrator, Model 808, is produced by Weston Electrical Instrument Corp, 617 Frelinghuysen Ave, Newark 5, N. J.

Unusual sensitivity of the model, according to the manufacturer, makes it ideal for such applications as: Integration of light (using a photronic photoelectric cell) falling upon a surface; d-c amp-hour integration from low potential shunts; watt-hour integration using thermal converters; and integration of nuclear radiation, in combination with proper counters or ionization chambers. The unit is chassis mounted and enclosed in an aluminum weatherproof case.

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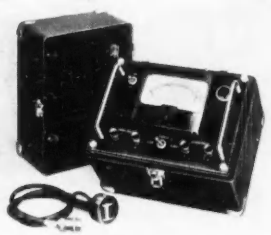


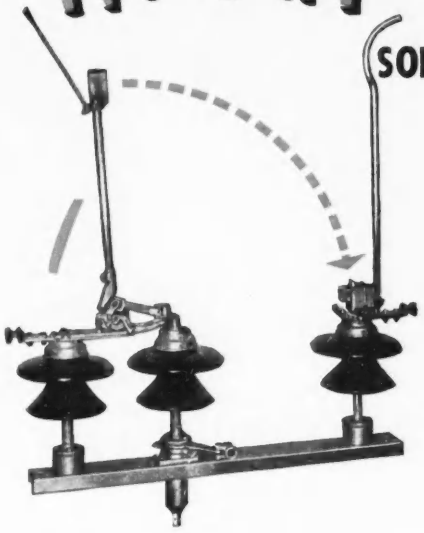
Thickness Indicator

FOR MEASURING the thickness of nonmagnetic coatings on iron or steel by the effect of reluctance changes in the magnetic circuit, the Coatingage measuring device is announced by Branson Instruments, Inc, Stamford, Conn.

Thickness is indicated directly on concentric scales covering a range of

IN-OUT 100,000 TIMES...

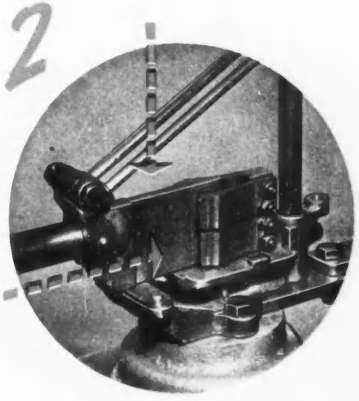
SOLVES YOUR SWITCHING PROBLEMS

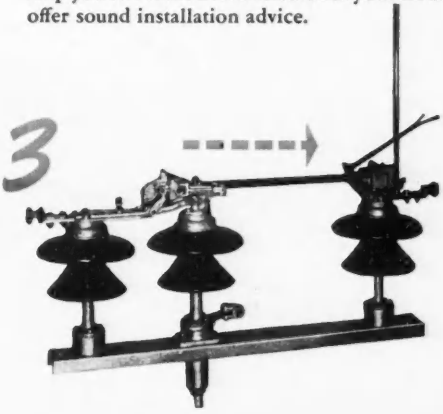


• You're watching the blade and contacts of a Hi-Voltage Switch close . . . firmly, positively and easily. This vertical "in-out" action has made contact life unlimited. Endurance tests in the laboratory . . . thousands upon thousands of switch operations . . . have shown no appreciable wear of Hi-Voltage contacts. We have never received an order for replacement contact parts. They don't wear out . . . they don't overheat . . . they don't need adjustment . . . they don't need cleaning.

The line-type contacts are silver-nickel, welded to copper . . . combine low resistance with low friction. Stainless steel springs maintain maximum conductivity. Operating effort is applied directly to the switch arm. A simple mechanical linkage controls the smooth, powerful motion. The entire switch is engineered to eliminate failure and wear.

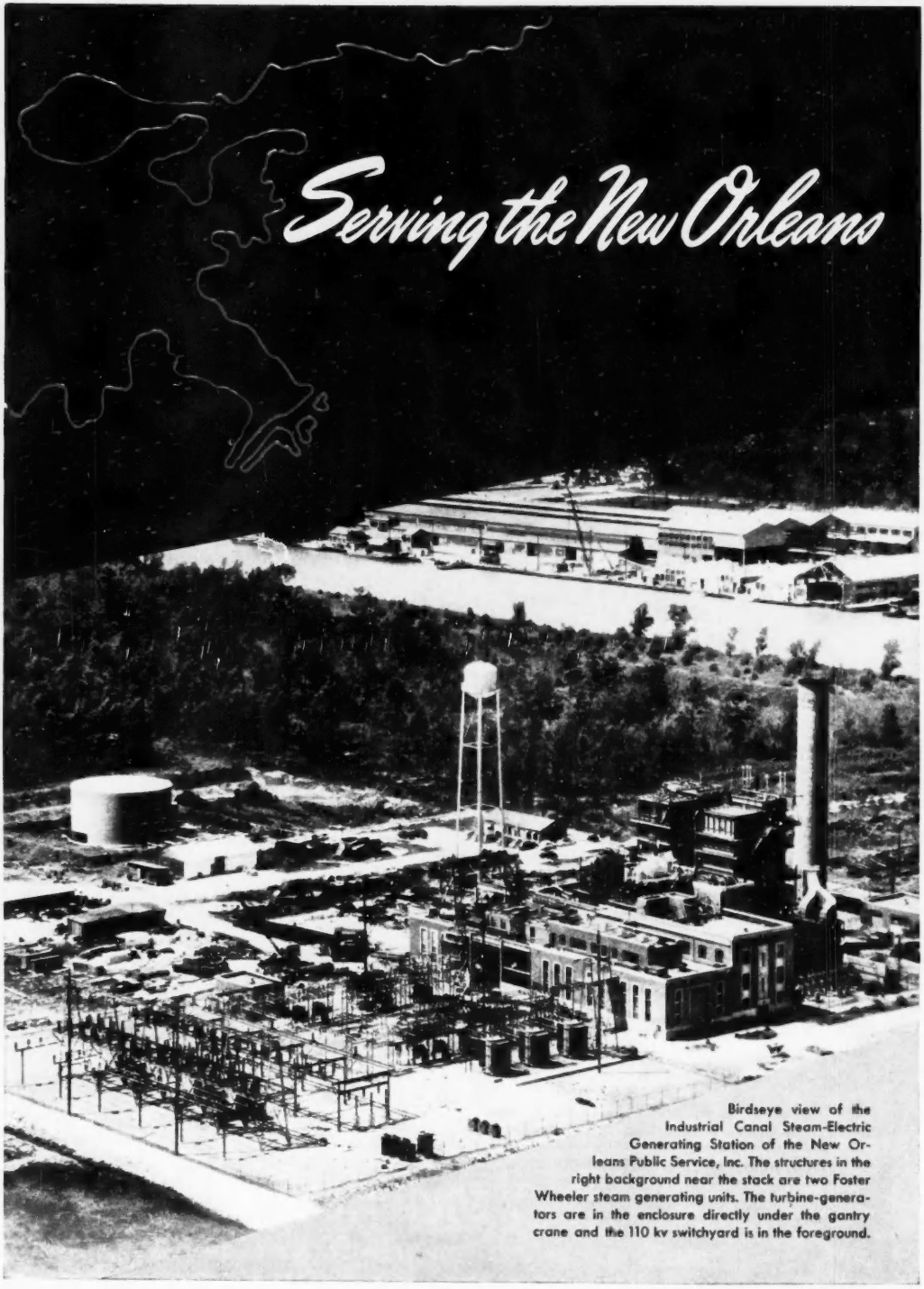
Ask your Joslyn salesman to show you more money-saving advantages of Hi-Voltage switches. He will help you select the best switches for your installations, offer sound installation advice.





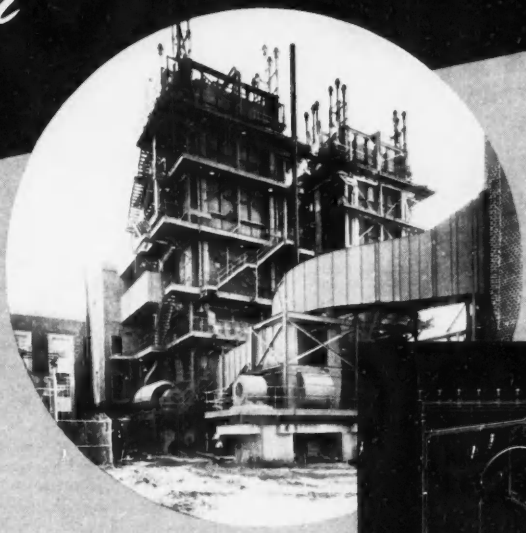
HI-VOLTAGE EQUIPMENT COMPANY

4000 EAST 116TH STREET • CLEVELAND 5, OHIO



Birdseye view of the Industrial Canal Steam-Electric Generating Station of the New Orleans Public Service, Inc. The structures in the right background near the stack are two Foster Wheeler steam generating units. The turbine-generators are in the enclosure directly under the gantry crane and the 110 kv switchyard is in the foreground.

area

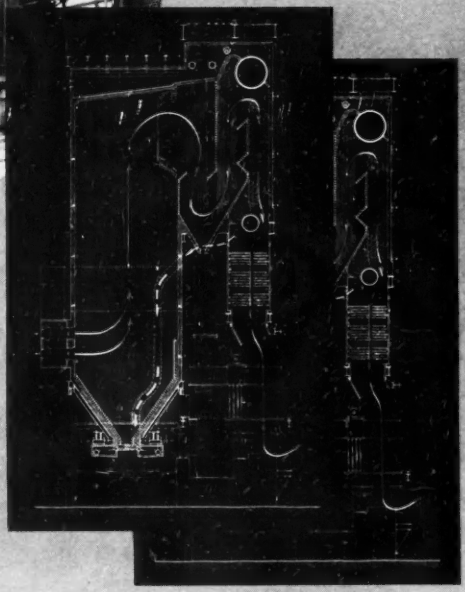


Two Outdoor Foster Wheeler Steam Generating Units for

Industrial Canal Steam-Electric Generating Station of

New Orleans Public Service, Inc.

Steam capacity per unit	400,000 lb per hr
Superheat control range	225,000 lb per hr to 400,000 lb per hr
Pressure superheater outlet	1,350 psi
Final steam temperature	955 F



The Industrial Canal Steam-Electric Generating Station of the New Orleans Public Service, Inc. is in consonance with the times which more than ever demand a sensible investment policy. This modern station combines lower investment cost of semi-outdoor construction with operating economies of a high pressure and high temperature steam cycle. Two 400,000 lb per hr FW steam generators, which are completely outdoors, serve two 37,500 kw turbines which are housed in individual semi-demountable enclosures directly under a single gantry crane.

The steam generating units are designed for firing natural gas, oil, or future pulverized coal and are arranged for automatic condenser-type steam temperature control.

FOSTER WHEELER CORPORATION, 165 Broadway, New York 6, N. Y.

FOSTER WHEELER

BERMICO* FIBRE CONDUIT

BERMICO CONDUIT IS REALLY RUGGED—IT'S BUILT TO TAKE ROUGH HANDLING ON THE JOB.
ITS CLEAN, SMOOTH BORE MAKES PULLING CABLES THROUGH BERMICO FIBRE CONDUIT QUICK AND EASY.

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WESTINGHOUSE ELECTRIC SUPPLY COMPANY
Offices in all leading cities

BERMICO FIBRE CONDUIT—A PRODUCT OF BROWN COMPANY

0.0001-0.5 in. Readings are claimed to be within 10% of actual thicknesses. The integral power supply consists of two 67½-v and 1½-v batteries.

MORE NEW PRODUCTS about which you should know

DV Welding Controls, Oakland 11, Calif., is producing an automatic start-stop **welding control** for electric driven d-c welders which enables the operator to start welder by striking an arc. . . . Federal Electric Products Co, 50 Paris St, Newark 5, N. J., makes Noark four and six-circuit **residence panels** in flush or surface mounting types which have UL approval. . . . Adjustable Fixture Co, Dept EW, 104 E. Mason St, Milwaukee 2, Wis., has announced the Ajusco-Loc **socket protector,** for providing maximum protection against breakage of lighting sockets, available in ⅛ or ⅜-in. IP thread as a separate assembly or complete with pull chain, key or push thru socket.

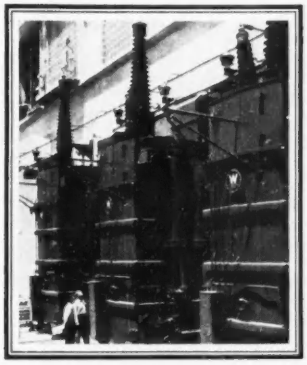
Dril-Hamer, Box 158, Planetarium Station, New York 24, N. Y., has introduced an **electric drill adaptor,** the Hamer-Dril, which converts any ¼-in. drill into a power hammer suitable for drilling tile, brick, cement and stone . . . The Miskella Infra-Red Co, Cleveland 4, Ohio, has available two portable, collapsible, non-tipping infrared **lamp stands** which provide a wide variety of position settings. . . . . L. S. Brach Mfg Corp, 200 Central Ave, Newark, N. J., is producing No. 376 **Stand-Off** for use with either twin lead-in or coaxial television antenna downleads.

Trico Fuse Mfg Co, 2948 N. Fifth St, Milwaukee 12, Wis, manufacturers a variable-feed **wick oiler** and filter recommended for solid bearings oiled from the top. . . . The Housing Foundation, Inc, Appliance Division, Deep River, Conn., announces a quick-heating **soldering tool,** called the Pres-To-Heat, designed for high-speed precision soldering. . . . Russell & Stoll Co, Inc, 125 Barclay St, New York 7, N. Y., offers a line of Midget Ever-Lok automatic **locking plugs,** receptacles and cord connectors for office, institutional and industrial use.

Sedgwick Machine Works, 80 Eighth Ave, New York, N. Y., produces a universal, contact making and/or breaking, Type CBN **switch** of small dimensions, rated at 250 v maximum; 2 amp, a-c; 1 amp, d-c. . . . G. M. Basford Co, 2020 Lincoln Bldg, New York 17, N. Y., has designed the Touch 'N' Grip **finger tool** for gripping nuts or bolt-heads in

WOULD YOU

RELY ON ELECTRICAL CONTROLS TO SAVE YOUR LIFE?



BLAW-KNOX Fog Nozzles* are electrically controlled. When temperatures rise suddenly, and dangerously, or approach a point above a pre-set maximum, electrical contacts are closed, deluge valves operated, fog nozzles are turned on, pump motors started, alarms sounded, fire doors and other devices actuated.

Blaw-Knox Sprinkler Systems are as reliable as electricity—and as fast in action. Blaw-Knox offers fire protection systems especially designed for transformer banks and other special applications.

ASK FOR BULLETIN No. 2207

STANDARD HEAD

Listed by Underwriters' Laboratories, Inc., and approved by Factory Mutual Laboratories.

FOG NOZZLE

*ALSO— Blaw-Knox offers Standard Wet and Dry Pipe Systems, as well as Thermostatically Controlled and Supervised Deluge Systems.

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SPRINKLER DIVISION
829 Beaver Ave., N. S.
Pittsburgh 12, Pa.

WHAT?

ONE *ELECTRICAL* MATERIAL FOR HIGH FREQUENCY SPLICING

YES! it's POLYKEN*

Amazingly versatile Bauer & Black Electrical Adhesive Tape #822

YOU'LL BE GLAD you tried POLYKEN when you see how neatly it eliminates the many packs, wraps, and dielectrics usually involved in splicing high-frequency apparatus.

YES . . . now this one versatile tape does everything . . . one handy roll of thin but amazingly strong oriented plastic film controls powerful electrical voltages, up to 1,000,000 volts on impulse tests . . . with a fraction of the bulk . . . in a fraction of the time required with more complicated methods. POLYKEN sticks with a touch . . . is easy and clean to use. Its polyethylene backing resists solvents, aging, and corrosion indefinitely.

GET A SUPPLY TODAY from your local jobber. Or for more information, write POLYKEN, Dept. 5-4, 2500 S. Dearborn St., Chicago 16, Illinois.

- **Dielectric Strength:** Over 10,000 volts (9 mils thick)
- **Insulation Resistance:** Greater than 8 x 10^6 megohms conditioned 24 hrs. @ 27° C — 70% R.H.
- **Dielectric Constant:** 2.6
- **Power Factor:** .0050 (10^6 cycles)
- **Corrosion Resistance:** No measurable corrosion effect
- **Solvent Resistance:** No known solvent for No. 822's backing at room temperature
- **Water Vapor Transmission Rate:** 0.24 gms per 100 sq. in. in 24 hours continuous immersion
- **Corona Quenching Characteristics:** Exceptional

*Reg. U. S. Pat. Off.

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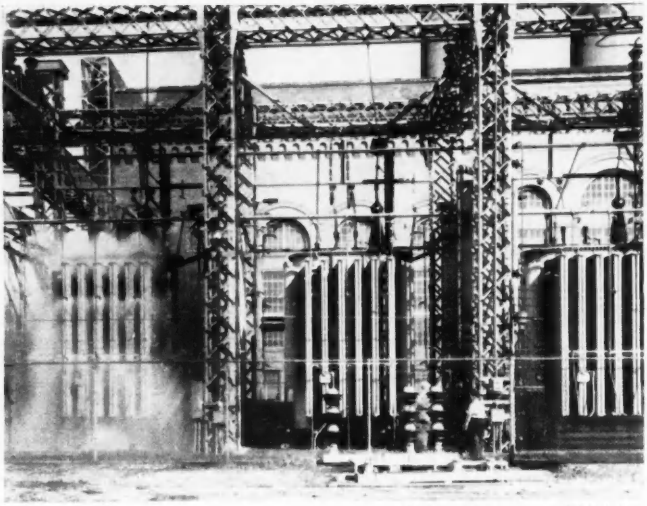
Division of The Kendall Company, 2500 S. Dearborn St., Chicago 16

Industrial Adhesive Tape
PRESSURE SENSITIVE

Production Short Cuts to Reduce Costs • Research to Speed and Improve Methods



Southern utility company's 15,000 KVA transformers under "Automatic" FIRE-FOG blanket of protection

Detect FIRE Fast!
Extinguish FIRE Instantly!

WITH "Automatic" FIRE-FOG

IT'S ELECTRICALLY SAFE AND FIRE SAFE

You don't have to be an economist to recognize the serious financial losses involved in fire incurred power failures in transformers and associated electrical equipment. They're losses that go far beyond the destruction visible to the human eye. Industrial out-of-service time for example, often far exceeds actual property damage, yet seldom is it evidenced in fire reports. . . . They're unnecessary losses too, for modern Automatic FIRE-FOG is now available for the protection of many types of electrical equipment. Detection of fire is automatic . . . FIRE-FOG operation instantaneous. From strategically located nozzles, a barrage of fine water spray is directed at the heart of the blaze. Flames are beaten down . . . the fire area cooled, and seconds later, extinguishment is complete with damage confined only to the point of fire origin. Power service may be readily restored and Automatic FIRE-FOG although composed of water, is electrically safe and carries the approval of all leading insurance authorities.

Industry's unremitting demands have past proved the safe, dependable and economical protection provided by Automatic FIRE-FOG. What it can do for you can best be told by one of our representatives who will gladly assist in your fire protection planning and furnish surveys and estimates without cost or obligation.

Automatic
FIRE-FOG
IT BLANKETS • IT ISOLATES • IT QUENCHES

. . . a famous member of the Automatic Sprinkler Family . . . provides basic fire protection for process equipment and storage in the chemical and petroleum industries. On-the-spot protection for quench tanks, dryers, explosive hazards, conveyor openings, air filters, oil filled electrical equipment and other units vital to production line operations.

"AUTOMATIC" SPRINKLER CORP. OF AMERICA
YOUNGSTOWN 1, OHIO

"Automatic" Sprinkler
FIRST IN FIRE PROTECTION
DEVELOPMENT • ENGINEERING MANUFACTURE • INSTALLATION
OFFICES IN PRINCIPAL CITIES OF NORTH AND SOUTH AMERICA

hard-to-reach places. . . . Ideal Industries, Inc, 1021 Park Ave, Sycamore, Ill., manufacturers the Stripmaster hand type **wire stripper** for wire sizes No. 22 to 8, which grips the wire, cuts the insulation and strips the wire in one operation.

American Laboratories, North Hollywood, Calif., have developed an all-purpose **plastic putty**, designated Nu-Era, which expands and contracts freely and is weather, water and fire-proof. . . . Farrelloy Co, 1245 N. 26th St, Philadelphia 21, Pa., has available corrosion-resistant machinable, Farreloy **solder**, in stick form, for use with any metal or combination of metals (in the presence of a suitable flux). . . . Meter Devices Co, Canton, Ohio, has black, Textolite **test switch covers**, insulated to prevent short-circuits when installed or removed, for panel board mounting.

Snap-on Tools Corp, Kenosha, Wis., announces a three-jaw **puller**, the CG-273, which can be locked to the work and will not come off until released. . . . Hexacon Electric Co, 206 W. Clay Ave, Roselle Park, N. J., produces a **soldering iron** rated at 700 w, 110 or 220 v, with protective hexagon-shaped housing and cooling fins. . . . Eisler Engineering Co, 750 S. 13th St, Newark 3, N. J., has developed 7.5 to 75-kva press type **spot welders** operated by a double acting air cylinder for high speed production.

Rockbestos Products Corp, New Haven 4, Conn., is offering a new line of heat and flame resisting, asbestos-varnished cambric **electrical wires** and cables for shipboard use which meet AIEE standards. . . . Electric Welding Alloys Corp, 40 Worth St, New York 13, N. Y., has announced the $\frac{1}{4}$-in. Eutectrode 24/49 **electrode**, with special Frigidare coating, for welding heavy cast iron castings. . . . Lindberg Engineering Co, Air and Hydraulic Division, 2444 W. Hubbard St, Chicago 12, Ill., is producing single stage **centrifugal blowers** which feature "full 360-deg positioning" of the air outlet.

National Electric Products Corp, Pittsburgh 19, Pa., has available a **Plug-In Strip** for baseboard mounting or chair-rail molding which permits selective control of home appliances at either wall or equipment location; three-slot receptacles are spaced at 18-in. intervals along the 24-gauge steel assembly. . . . The Kindorf Co, 681 Market St, San Francisco 5, Calif., manufactures a 500-lb capacity **channel clamp** for supporting conduit from structural channels or angles through which drilling is not desirable. . . . Safety & Maintenance Co, Inc, New York, N. Y., has an improved **absorbent compound** called Sol-Speedi-Dri for application on floors where grease and oil exist.

This flag means safety

VINYLITE Brand Plastics have what it takes – and a lot more – to meet the rigorous Underwriters' Laboratories safety specifications for wire insulation... specifications so important to fire prevention! The molded-on plug, making it an integral part of the cord set, is an added safety feature.

Whether used for non-metallic sheathed cable, appliance cords, or portable cords, VINYLITE Brand Plastics readily withstand the pulls, crushing, impact and abrasion encountered in actual service. They are flame-resistant. The smaller diameters they make possible provide more circuits per conduit.

Available in any color for decoration or identification, VINYLITE Brand Plastics are resistant to water, oils, greases, alkalis, and most acids. They are easy to pull and strip. Aging is no problem.

Full information on VINYLITE Plastics insulation is a "must" to anyone engaged in building, remodeling, or rewiring residential and business structures. For a list of manufacturers who now use VINYLITE Brand Plastics insulation, write Department EY-28. Technical representatives are available to industrial organizations for consultation on wire and cable problems.

Vinylite BRAND PLASTICS

BAKELITE CORPORATION

BAKELITE CORPORATION, *Unit of Union Carbide and Carbon Corporation* UCC 30 East 42nd Street, New York 17, N.Y.

Jenkins Bros. also make Diamond Seal Friction and Rubber Tapes which meet ASTM and Federal Specifications.

TAPE that you can count on in emergencies . . . that's Gold Seal! Rigid laboratory controlled production assures plenty of lasting "tack" in the friction compound . . . with every fiber of the top quality base cloth thoroughly impregnated.

And you can't beat Gold Seal for ease of handling. It tears easily, evenly . . . and will not dry out, peel, ravel, or smear the hands . . . yet it consistently gives a tighter, longer-lasting bond.

Try Gold Seal and see the difference. It comes in single rolls or handy 10-roll containers . . . each roll cellophane wrapped. Jenkins Bros., (Rubber Div.), 80 White Street, New York 13, N. Y.

JENKINS Gold Seal Tapes

FRICTION and RUBBER TAPES

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New Subscription Order

3 years of "Electrical World" for $12 ☐

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Your Signature_____ Position_____

Home Address_____

City_____ P. O. Zone____ State_____

Company_____ Dept._____

(Rates Quoted for U. S. and Possessions Only) W-4-23-49

New Subscription Order

3 years of "Electrical World" for $12 ☐

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CHECK HERE IF YOU PREFER ☐ 2 YEARS FOR $9 OR ☐ 1 YEAR FOR $6

Your Signature_____ Position_____

Home Address_____

City_____ P. O. Zone____ State_____

Company_____ Dept._____

(Rates Quoted for U. S. and Possessions Only) W-4-23-49

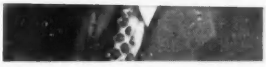
Share Co, and Winnipeg Hydro.

At the present time, Mr Young is chairman of the adequate wiring committee of the Canadian Electrical Manufacturers Association.

•

J. S. Newbold, test superintendent of the Cape Fear steam electric generating plant of the Carolina Power & Light Co since 1946, has been appointed superintendent of the company's steam electric generating plant now under construction near Lumberton, N. C.

George H. Fritzinger, Pennsylvania Power & Light Co operating department engineer, has been appointed to the newly created position of budget director in the company's financial department. **Edmond L. Somers,** now assistant to the supervisor of load in the system operating department at Hazleton, will succeed Mr Fritzinger. Mr Fritzinger has held various engineering positions with PP&L since 1926. After serving at Pottsville, Allentown, and Hazleton he returned to Allentown to



LAWRENCE J. DYKSTRA

charge of the company's advertising and sales engineering.

Mr Dykstra has been associated with the insulator business for the past 11 years as a sales and production executive.

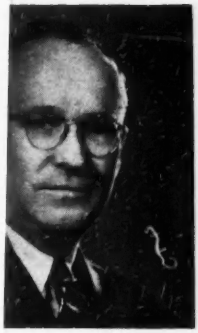
•

Earl I. Mead of Scottsbluff, Neb., has been elected president of the Consumers Public Power District, Columbus, Neb.

Maj Robert J. Hall has been appointed special assistant to Col O. E. Walsh, Portland (Ore.) district engineer in charge of all flood control design and construction programs in the Portland district, except those in the Willamette Basin. Major Hall, who joined the Portland district last year, has been attached to the power plant design branch.

Assumes Broader eering Assignment

Cranston has been apral superintendent of sub-Vest Penn Power Co, Pitts-



N. CRANSTON

e 1938 he has been superinall the substations in the served by the company.

ston joined West Penn in Washington, Pa. The fol- he was transferred to engineering work and substation design in West Penn's Pittsburgh office. In 1917 he was named assistant superintendent of substations for the company's territories B and C. In 1923 he was made superintendent for these territories. His appointment as superintendent of all substations, main areas, followed.

•

W. B. Wolfendale, who directed construction of $28,000,000 Ross Dam for Seattle City Light, has retired after 31 years of service with the city, first with the city engineering department, but principally with City Light. His first assignment was as a junior engineer on the construction of Diablo Dam. He rapidly worked up to the position of senior associate engineer and, after completion of Diablo in 1930, directed construction of bridges for City Light's Skagit Railway and pipelines at Cedar Falls. In 1936, Mr Wolfendale was appointed assistant resident engineer for Ross Dam, while the dam was being designed. When construction began in 1937, he was placed in charge of the

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JENKINS *Gold Seal Tape*

FRICTION and RUBBER TAPES

MADE BY JENKINS BROS. . . . MAKERS OF FAMOUS JENKINS VALVES

NEWS ABOUT PEOPLE

D. S. Young Appointed V-P of Powerlite Devices, Ltd

Dudley S. Young, for the past four years assistant general sales manager of Canada Wire & Cable Co, has been

DUDLEY S. YOUNG

appointed vice-president of Powerlite Devices, Ltd, Toronto.

Mr Young's previous experience consisted of 16 years as district engineer for Anaconda Wire & Cable Co in Chicago, also utility experience with Detroit Edison Co, Electric Bond & Share Co, and Winnipeg Hydro.

At the present time, Mr Young is chairman of the adequate wiring committee of the Canadian Electrical Manufacturers Association.

•

J. S. Newbold, test superintendent of the Cape Fear steam electric generating plant of the Carolina Power & Light Co since 1946, has been appointed superintendent of the company's steam electric generating plant now under construction near Lumberton, N. C.

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•

L. J. Dykstra Directs Pinco Sales Engineering

Lawrence J. Dykstra, who joined the Porcelain Insulator Corp, Lima, N. Y., staff last September, has been placed in

LAWRENCE J. DYKSTRA

charge of the company's advertising and sales engineering.

Mr Dykstra has been associated with the insulator business for the past 11 years as a sales and production executive.

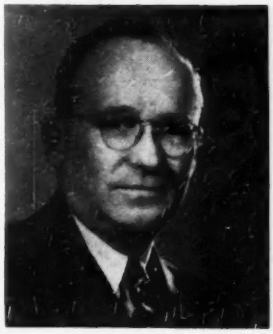
•

Earl I. Mead of Scottsbluff, Neb., has been elected president of the Consumers Public Power District, Columbus, Neb.

Maj Robert J. Hall has been appointed special assistant to Col O. E. Walsh, Portland (Ore.) district engineer in charge of all flood control design and construction programs in the Portland district, except those in the Willamette Basin. Major Hall, who joined the Portland district last year, has been attached to the power plant design branch.

Cranston Assumes Broader Engineering Assignment

Robert W. Cranston has been appointed general superintendent of substations for West Penn Power Co, Pitts-



ROBERT W. CRANSTON

burgh. Since 1938 he has been superintendent of all the substations in the main areas served by the company.

Mr Cranston joined West Penn in 1914 at Washington, Pa. The following year he was transferred to engineering work and substation design in West Penn's Pittsburgh office. In 1917 he was named assistant superintendent of substations for the company's territories B and C. In 1923 he was made superintendent for these territories. His appointment as superintendent of all substations, main areas, followed.

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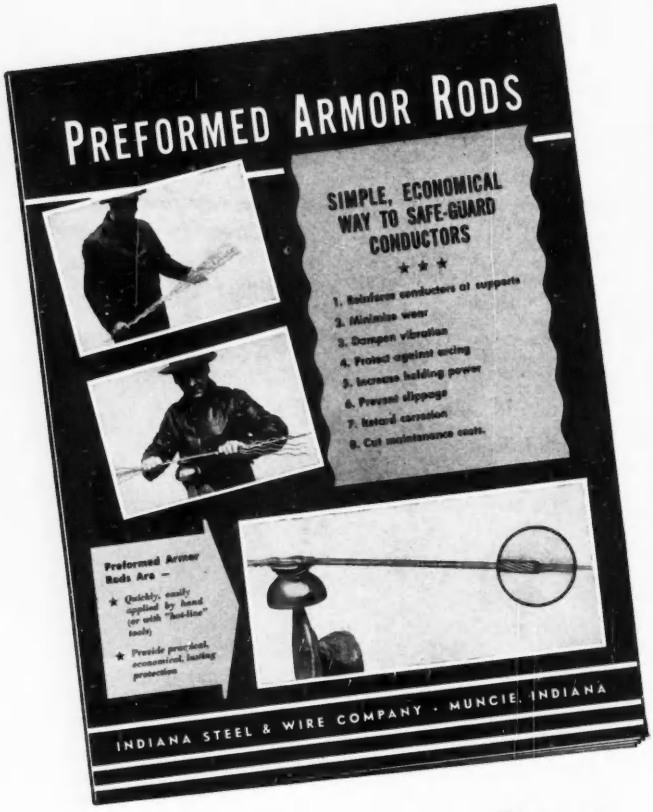
W. B. Wolfendale, who directed construction of $28,000,000 Ross Dam for Seattle City Light, has retired after 31 years of service with the city, first with the city engineering department, but principally with City Light. His first assignment was as a junior engineer on the construction of Diablo Dam. He rapidly worked up to the position of senior associate engineer and, after completion of Diablo in 1930, directod construction of bridges for City Light's Skagit Railway and pipelines at Cedar Falls. In 1936, Mr Wolfendale was appointed assistant resident engineer for Ross Dam, while the dam was being designed. When construction began in 1937, he was placed in charge of the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1. Reinforce conductors at supports
2. Minimize wear
3. Dampen vibration
4. Protect against arcing
5. Increase holding power
6. Prevent slippage
7. Retard corrosion
8. Cut maintenance costs.
Preformed Armor Rods Are —
★ Quickly, easily applied by hand (or with "hot-line" tools)
★ Provide practical, economical, lasting protection
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PREFORMED ARMOR RODS provide a simple, practical, economical method of reinforcing and protecting overhead conductors at the point of and in the region of the supports. They minimize wear and chafing, tend to absorb and dissipate vibration, protect the conductor against arching and flash-overs, afford increased holding power against slippage, lessen the possibilities of corrosion, reduce overall maintenance expense.

Easily applied by hand or with "hot line" tools. Available in galvanized or stainless steel, aluminum, copper or bronze.

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work as resident engineer. His title was changed to project engineer in 1943.

•

New Appointments Made by Westinghouse Electric

One executive and several engineering appointments have recently been announced by the Westinghouse Electric Corp.

George G. Main of Pittsburgh has been elected treasurer to succeed the late L. H. Lund. Mr Main had served as assistant treasurer and assistant secretary since 1945. His headquarters will be in Pittsburgh.

G. L. MacLane, Jr. has been made assistant manager of the engineering laboratories and standards department and **Dr L. J. Berberich** has been named manager of the liaison section of this department. Mr MacLane was on the instructing staff at the University of Arizona and with the Central Arizona Light & Power Co before joining Westinghouse in 1936. Dr Berberich became identified with Westinghouse as a member of the insulation department, research laboratories, in 1937.

Two appointments in the sales department of the meter division, Newark, N. J., have been made. **John M. Nelson,** formerly in charge of relay sales, became manager of meter sales, and **J. F. Chapman** succeeded him as manager of relay sales. Mr Nelson joined the company in 1926. Mr Chapman has been serving in various capacities in the meter division engineering department since 1933. He joined the company three years earlier.

John Z. Linsenmeyer has been appointed manager of mining, petroleum, and chemical engineering. He succeeds **Phelan McShane,** who has been appointed consulting mining engineer for the company. Mr Linsenmeyer became identified with Westinghouse in 1937.

Robert L. Zahour has rejoined the Lamp Division, Bloomfield, N. J., and will handle special lamp applications. Mr Zahour was formerly an illuminating engineer in the company's lighting department, but he left in 1935 to head lighting and rural electrification promotion for the Connecticut Light & Power Co in Hartford. When World War II began, Mr Zahour was appointed executive assistant and chief engineer of the Newark (N. J.) Safety Council. Two years later, he joined North American Philips with headquarters in New York City.

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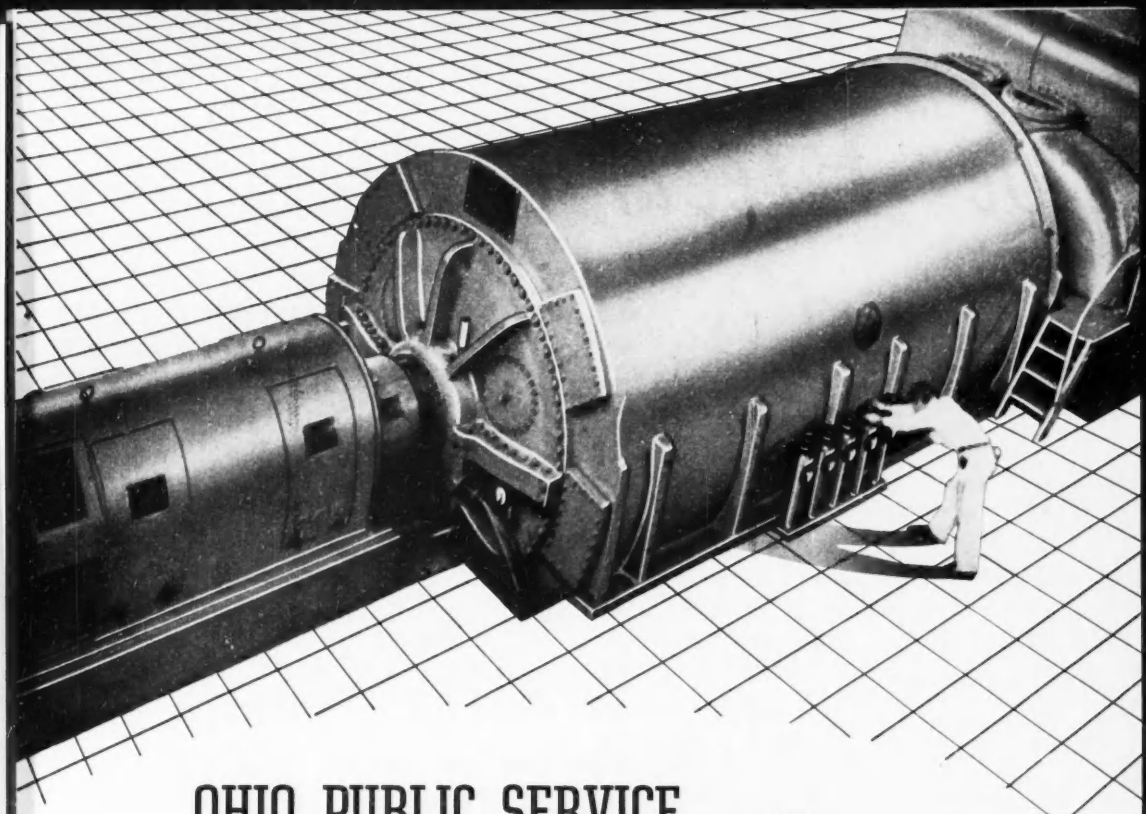
Edmond C. Powers, director of public information, The Street and Traffic Safety Lighting Bureau, Cleveland,



OHIO PUBLIC SERVICE *specifies*

HONAN-CRANE for Turbine Oil Purification in 5 plants

The Ohio Public Service Company has used Honan-Crane oil purification equipment continuously for seven years, now has Honan-Crane installed in five of its big Ohio generating stations which produce a total of 470,000 kilowatts.

Ohio Public Service first installed a Honan-Crane purifier in the Mahoningside station at Warren, Ohio, in December, 1941, and since that time has purchased additional purifiers for generating stations located at:

R. E. Burger Station	**Dilles Bottom, Ohio**	**230,000 kw**
Edgewater Station	**Lorain, Ohio**	**100,000 kw**
Mahoningside Sta.	**Warren, Ohio**	**82,000 kw**
Scioto Station	**Marion, Ohio**	**38,000 kw**
Melco Station	**Mansfield, Ohio**	**20,000 kw**

Using Cranite (specially processed fullers earth), stations are able to operate continuously with turbine oil held to safe, low neutralization and steam emulsion numbers. At the R. E. Burger station a variable schedule of purification has been established. Cellulose fibre is used as the regular filtering medium and is replaced by Cranite where the S. E. or neut numbers rise above specified limits. This more economical plan of purification is easy to accomplish because of the flexibility of Honan-Crane purifiers in accommodating either type of filtering media.

Honan-Crane oil purification equipment maintains Turbine oil in its original clean condition, removing oil contaminants as rapidly as they appear. Maximum turbine operating efficiency is possible and safe use life of oil extended because Honan-Crane purifiers give control over type of contamination that causes neutralization and S. E. numbers to rise beyond desired limits. For complete information on turbine oil purification, and Honan-Crane oil purifiers, write to 819 Wabash Avenue, Lebanon, Indiana.

the Electric Power past . . .

Electrical World's examination of the electric power industry, to be published in the 75th Anniversary Edition on May 21, is no mere record of events.

It tackles each step in the process of making and supplying electrical energy. It sets down the reasons behind each new product development and the demands that brought about each advance in plant and system design.

And it goes beyond engineering and operations. It tells the story of marketing electricity, of management, of organization, rate making, and financing.

In this way, the current status of the art is presented with the purpose of indicating future trends in system and product evolution.

We believe you'll want to devote more than ordinary time and attention to this issue of Electrical World. At the right we've listed an outline of the editorial plan.

remember the date . .

Industry present ... and future

EDITORIAL PLAN

INTRODUCTION
- Electrical World—Yesterday and Today
- Electrical World—Technical Reporter and Sponsor of Development

GROWTH OF THE ELECTRICAL INDUSTRY
- The Private Electric Utility Systems
- Industrial Power Systems
- Municipal Utility Systems
- Federal Power Systems

POWER PLANT GENERATION EQUIPMENT
- Power Plant Performance Objectives
- Fuel Utilization and Steam Generation
- Steam Turbines and Condensers
- Turbo and Hydro Alternators

POWER STATIONS
- Excitation and Auxiliary Systems
- Station Bus Patterns
- Control Boards
- Switchgear and Power Fuses

TRANSMISSION
- Transmission Design
- Transmission Operation and Maintenance
- Power Transformers
- Protective Relaying
- Power Cables

GENERAL SYSTEM
- System Grounding
- System Communication and Telemetering
- System Voltage Regulation

DISTRIBUTION
- Substations
- Distribution Systems
- Distribution Transformer
- Distribution Reliability

MAINTENANCE AND METERING
- Line Construction Methods
- Insulation Test and Maintenance
- Power Metering

EXPANSION IN USE OF ELECTRICITY
- Development of Utilization Equipment
- Sales Promotion
- Development of Rural Electrification

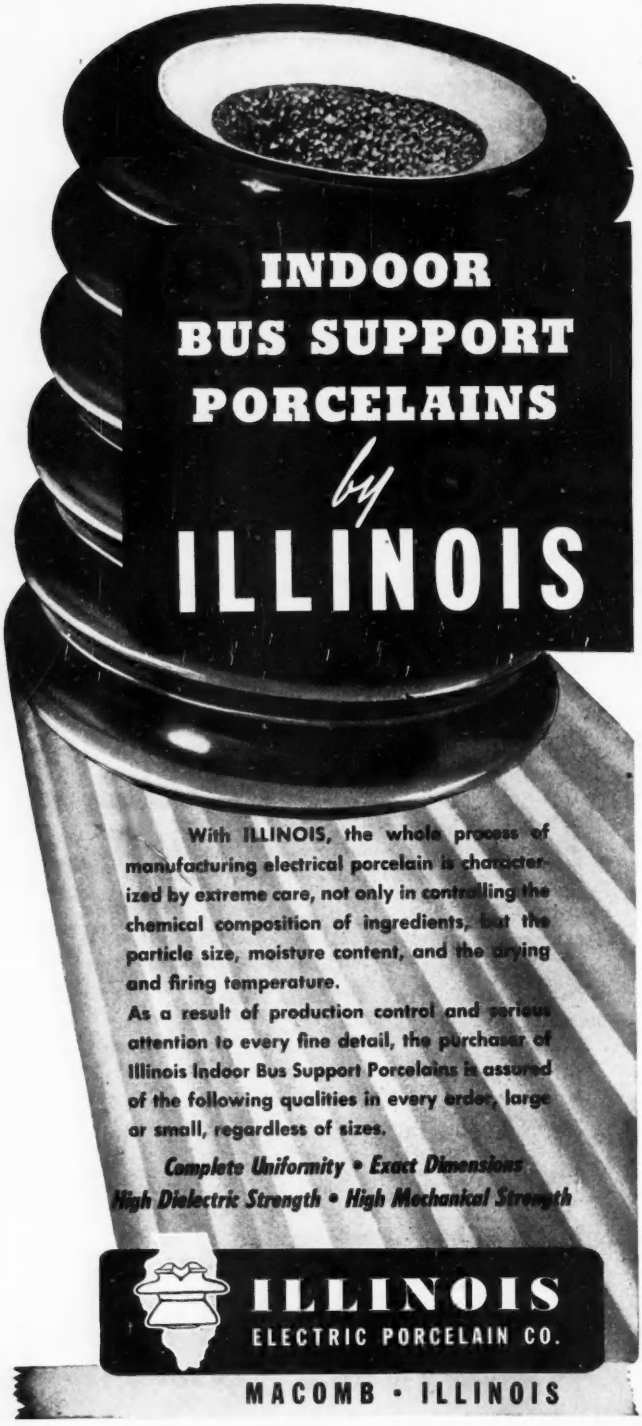
ORGANIZATION AND REGULATION
- The Holding Company
- Development of State Regulation
- Developments in Rate Making

INDUSTRY ORGANIZATIONS
- NEMA
- EEI
- AEIC
- Area Organizations

...May 21st

ELECTRICAL WORLD

330 West 42nd St. New York 18, New York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BUS SUPPORT
PORCELAINS
by
ILLINOIS
With ILLINOIS, the whole process of manufacturing electrical porcelain is characterized by extreme care, not only in controlling the chemical composition of ingredients, but the particle size, moisture content, and the drying and firing temperature.
As a result of production control and serious attention to every fine detail, the purchaser of Illinois Indoor Bus Support Porcelains is assured of the following qualities in every order, large or small, regardless of sizes.
Complete Uniformity • Exact Dimensions
High Dielectric Strength • High Mechanical Strength
ILLINOIS
ELECTRIC PORCELAIN CO.
MACOMB • ILLINOIS

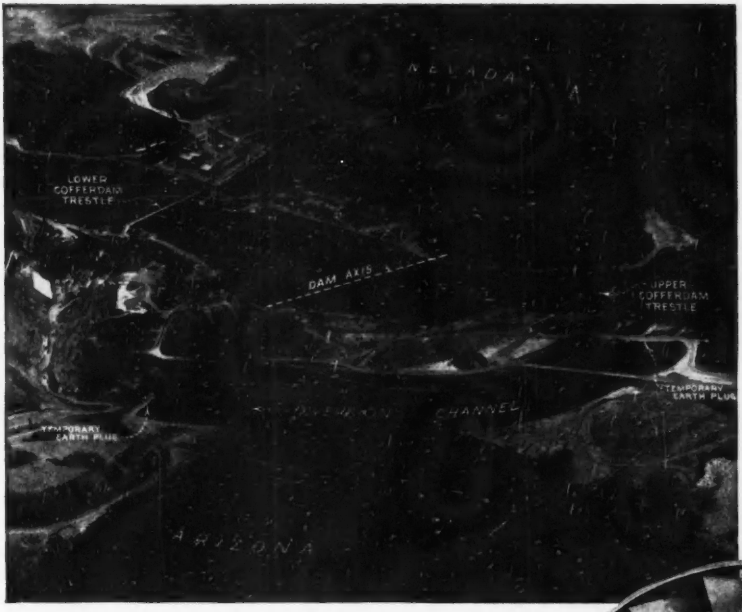
Ohio, has been appointed a member of the Committee on Organized Public Support of the President's Highway Safety Conference, which is to meet in Washington, June 1-3.

Robert L. Murray, executive vice-president of Hooker Electrochemical Co. Niagara Falls, N. Y., has been named winner of the Jacob F. Schoellkopf medal for 1949. The medal is awarded annually by the western New York section of the American Chemical Society for accomplishment in the field of science and research in industry.

Robert M. Oliver has been appointed to the newly created position of general merchandise manager of the traffic appliance division of Landers, Frary & Clark, New Britain, Conn. Widely known in the electric appliance marketing field, Mr Oliver was formerly vice-president in charge of sales of the Proctor Electric Co. In addition to his wide experience with producers of appliances, he has spent ten years in the retail sale of appliances with utilities, including a three-year period as traffic appliance sales manager of the Iowa-Nebraska Light & Power Co.

G. W. Orr has been appointed vice-president of the National Stamping & Electric Works, Chicago, of which Chicago Electric Manufacturing Co is the parent organization. Mr Orr will operate as manager of the appliances manufactured by National Stamping and also of the special products division of both companies. He was formerly with the General Electric Co as traffic appliance representative in Philadelphia and later was in charge of the Philadelphia branch of the OPA housewares and appliances department. Following service in the Navy, Mr Orr became divisional sales manager for the D. E. Sanford Co, Chicago.

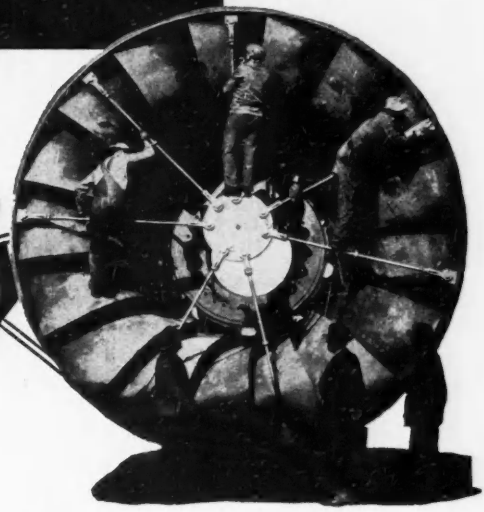
S. Floyd Stewart, executive vice-president of the Lecce-Neville Co, Cleveland, since 1946, has been elected president of that organization. He succeeds the late co-founder, B. M. Lecce. **Charles S. Cook,** for eight years the company's assistant to the president, has been elected a vice-president. Mr Cook was named treasurer and elected to the board at a meeting held last December. Mr Stewart joined the Lecce-Neville organization as a research engineer in 1936. Previously he had been associated with General Electric Co, Wagner Electric Corp, Colin B. Kennedy Corp, and Jensen Manufacturing Co. Mr Stewart became chief engineer at Lecce-Neville in 1941; vice-president in charge of engineering in 1945; and executive vice-president in 1946. Joining the company as assistant to the president in 1941, Mr Cook was made assistant secretary



Aerial view showing proposed diversion of the Colorado River at the Davis Dam site.

First Davis Dam runner upon arrival at the Bureau of Reclamation storehouse enroute to the dam site. Workmen are unbolting the steel "spider" used to brace the runner during shipment.

DESTINATION— DAVIS DAM



Between 800,000,000 and 1,000,000,000 kilowatt hours of badly needed electrical energy will be added to the nation's annual power supply with the completion of Davis Dam. Last link in a comprehensive plan to conserve and utilize the waters of the Colorado, this dam will impound 1,800,000 acre-feet of water, and harness every available foot of head between the site and the Hoover Dam tail race.

Five giant Baldwin turbines, each with a rating of 62,200 HP under a 120-foot head, will turn the 45,000 kva generators. Two of the turbine runners—the largest ever cast in one piece—have already been shipped after machining at Baldwin. The remaining three will soon be on their way. Baldwin equipment, reinforced by Baldwin experience, has helped in the development of some of the world's largest hydro-electric projects.

BLW THE BALDWIN GROUP **BALDWIN**

HYDRAULIC TURBINES

THE BALDWIN LOCOMOTIVE WORKS
Philadelphia 42, Pa.

THE PELTON WATER WHEEL COMPANY
2929 Nineteenth Street, San Francisco 10, Calif.

Offices: Boston, Chicago, Cleveland, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Seattle, St. Louis, Washington. In Canada: Baldwin Locomotive Works of Canada, Ltd., Toronto, Ontario.

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Insulators
CAP and PIN TYPE
NEMA Standard Strength B.I.L.
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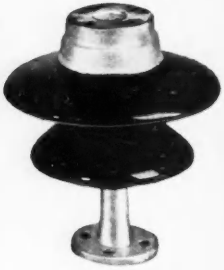
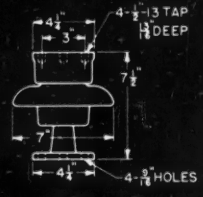
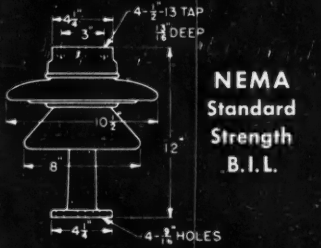
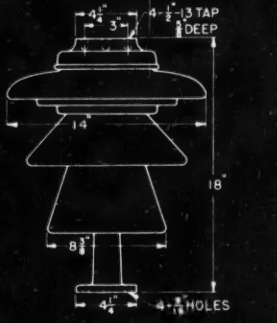
JEFFERY-DEWITT INSULATOR CORP.
KENOVA, WEST VIRGINIA
U. S. A.









in 1948. **Harold J. Zuske** has been named to head original equipment sales for the company. He succeeds **Kenneth C. Gano,** who resigned after heading the company's sales and advertising activities for the past eight years. Mr. Zuske has been with Leece-Neville for 13 years.

William R. Patton, formerly radio engineer, United Air Lines, has joined the Lenkurt Electric Co, San Carlos, Calif., as a field engineer in the carrier-equipment division.

OBITUARY

William H. Barthold

William H. Barthold, prominently identified with the public utility industry for a number of years and an executive of utilities in the Commonwealth & Southern system for 43 years, died on Apr 11 at the age of 74.

Mr Barthold was chairman of the board of directors of the Central Illinois Light Co, Peoria, and president of the Southern Indiana Gas & Electric Co, Evansville, when he resigned in 1944. Poor health obliged him to forego his usual activities. At the time of his death he was a member of the board of the Southern Indiana Gas & Electric Co.

•

Edwin H. Kifer, manager of the San Antonio (Tex.) City Public Service Board, died in that city on Apr 14 at the age of 64. Before the city acquired the utility properties in San Antonio, Mr Kifer was vice-president and general manager of the San Antonio Public Service Co. His early utility experience was obtained with the Madison (Wis.) Gas & Electric Co. He served in various engineering capacities, including superintendent of the electrical department and general superintendent. It was in 1918 that he went to San Antonio. Mr Kifer had been active in the old National Electric Light Association and in the affairs of the American Institute of Electrical Engineers, of which he was a fellow.

Harry M. Hooker, former president and retired chairman of the board of directors of the Hooker Electro-Chemical Co. died on Apr 9 at Niagara Falls, N. Y. He was 75 years old. Mr Hooker joined the Hooker company in 1913, a few years after his brother had founded the company. He advanced from superintendent of construction to vice-president and sales manager in 1922. Upon his brother's death in 1938, he was elected president and in 1945 he was named chairman of the board. This position he held until he resigned last January.

U.S. RUBBER COMPANY

Proudly Announces

The FIRST NEOPRENE-JACKETED SERVICE ENTRANCE CABLE

Accepted by UNDERWRITERS' LABORATORIES* and with Laytex® Insulation

You've never seen a service entrance cable like this! Neither had Underwriters' Laboratories. This great new U. S. Product answers the demand for a cable that will *not* festoon.

Underwriters' put the cable through a rough series of tests. Here are the results:

Dripping of compound at high temperatures: None.

Bending at low temperature: No damage sustained.

Flame Test: No burning of the paper indicator, nor any persistence of flame after last application of the test flame.

NOMINAL DIMENSIONS		
SIZE	NEOP. JACKETED	STD. BRAID
3-6	.47 x .74	.56 x .86
2-6 & 1-8	.45 x .73	.55 x .85
3-8	.38 x .62	.50 x .76

Note smaller diameter of this new cable compared to diameter of standard braid.

High Current Test: Cable did not flame, rupture, nor warp excessively.

Di-electric strength: No electrical breakdown as a result of this test.

Conductor Pull-Out tests: Using three different connectors, the U. S. Cable *held three times better* than standard design cables.

Rough Handling at Low Temperatures: A coil of the cable was exposed for 5 hours to a temperature of minus 34.4 C. It was then dropped 8 feet to a concrete floor. No breaks or cracks in the Neoprene sheath occurred.

Abrasion: The outer covering of the U. S. Cable proved to be over 10 times more abrasion-resistant than that of conventional design.

Write today for information to Electrical Wire and Cable Department, United States Rubber Company, 1230 Avenue of the Americas, New York 20, N. Y.

* Underwriters' Laboratories, Inc. — Test Service — Not for Profit — Sponsored by National Board of Fire Underwriters

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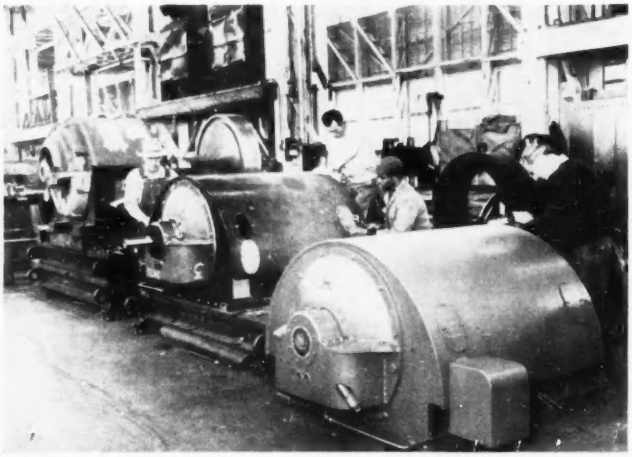
U.S.RUBBER — SERVING THROUGH SCIENCE

UNITED STATES RUBBER COMPANY

MANUFACTURERS and MARKETS



RECENTLY COMPLETED and shipped, these two 1,000-hp electric motors, most powerful built to date by Westinghouse at its Sunnyvale, Calif., plant, will shortly be doing a vital job at the Los Angeles Airport, pumping fuel that will burn away fog. This photograph shows the two motors during manufacture. To the right is a nearly completed unit, while to the left a second motor is under construction

Urges Two-Pronged Educational Plan for Electric Appliance Industry

Electric cooking will outsell competitive fuels within five years, Leonard C. Truesdell, vice-president of marketing, Hotpoint, Inc, told the Electric League of Western Pennsylvania at a recent meeting.

December figures show that for the first time in history manufacturers shipped more electric than gas ranges, he said. "I feel that this marks a turning point in the appliance industry. Electric cooking has come of age." Mr Truesdell warned that team work among all elements of the electrical industry "is essential if we are to continue growing and progressing in the years ahead."

Discussing factors which have contributed to present acceptance for electric ranges, he said that the latest figures of the United States Bureau of Labor Statistics give a remarkably dramatic picture of reduction in electric service costs. Based on the year 1914 representing 100, electric service costs today have an index of approximately 57 compared with gas service costs with an index of approximately 110. At the same time the cost of living is just about twice the 1914 index.

Commenting on future markets, Mr Truesdell said, "Many of us have not fully considered the vast potential represented by the farm market. . . . Gross farm income in 1948 amounted to more than $40 billion, the highest in history, and $1.6 billion over the 1947 figure. It is important to remember that while inflation has reduced the purchasing power of the dollar, farm income in 1948 was three times the 1935-39 average. In other words, in 1948 every farm in the United States had an income of $5,200. . . . Surveys reveal that farmers have set aside large portions of their savings for building materials, automobiles, and major household equipment.

"Electricity now is available to 87% of all the farms in this country. By 1951 it is estimated that 96% of the nation's farms will be served by electricity. . . . It has been estimated that the national farm market will absorb $5 billion worth of electric appliances by 1954."

Mr Truesdell said that as the new champion, electric cooking must be prepared to take on all comers. "And from where I sit, it looks as if the new challenger will be the liquified petroleum gas industry. During the war, when electric power generating expansion for residential use was stopped, when electric range production was practically non-existent, 4,000,000 L-P gas ranges were sold and installed. If that doesn't wake you up, listen to this. In 1922 about 22,000 gal of L-P gas were marketed. Last year the market for this fuel was 905 billion gal. L-P customers have increased from 5,000 in 1922 to more than 2,000,000."

Mr Truesdell concluded that "in order to guarantee our future, we must carry out a two-pronged educational program aimed at consumers and retailers. We must educate consumers to the advantages of electric living. We must have a strong, well-trained, retail organization that recognizes its full responsibility as a member of the electrical industry team. Our economy now has returned to the normal pattern of competitive selling."

•

$1,000,000 Steel Mill Drive

A $1,000,000 electric drive for the McLouth Steel Corp's new 42-in. hot strip finishing-mill in Detroit will be built by the Westinghouse Electric Corp. Output from the mill will provide additional sheet steel for the Detroit area. The drive equipment will include a 5,000-hp motor, a 4,000-kw motor-generator set, and some 300 auxiliary motors. The auxiliary motors, used for handling the sheet steel, will range from two to 300 hp.

•

Isolantite Reorganized

Reorganization of Isolantite, Inc, has been completed. Formerly of Belleville, N. J., Isolantite Mfg Corp is located at

Warren St, Lyndhurst, N. J. Plans for a new plant are being completed, with the move expected in the near future. Frank J. Stevens has been elected president; Paul H. Mouraud, vice-president and treasurer, and John Simons, secretary.

•

Power Return Restores Normal Aluminum Output

Pacific Northwest aluminum production has returned to normal with the restoration to the industry of 66,000 kw of electric power cut off by BPA in November in an effort to ease the power shortage.

Another 66,000 kw will enable the aluminum industry to produce an additional 5,000,000 lb per month.

The Aluminum Corp of America plant at Vancouver, Wash., is receiving more than 36,000 kw of the added power; Permanente Metals at Spokane, about 25,000; and Reynolds Metals at Longview, Wash., 6,000.

•

UAW Wins Election at Two Allis-Chalmers Plants

Employees at two Allis-Chalmbers plants in Springfield, Ill., voting on Apr 15 in a National Labor Relations Board election, chose the United Auto Workers, CIO, as the union to represent them as bargaining agent with the company. Until this balloting the Farm Equipment Workers, another affiliate of the CIO, represented the workers.

The vote in favor of the UAM was 1,974 against 722 for FE and 26 for neither union.

All production and maintenance employees were eligible to vote. Voting was agreed on by representatives of the two unions, an Allis-Chalmers official, and an NLRB field examiner.

•

Cuts Silicon Steel Price

The Allegheny Ludlum Steel Corp on Apr 18 reduced its base price on one grade of silicon sheet steel about 20%. Transformer grade "C" used in electrical apparatus manufacture was reduced from $10.05 for 100 lb to $8.05 to meet competitive prices.

•

Plans Plant Addition

Plans are being made to construct a $100,000 addition to the present plant building of the Standard Transformer Co, Warren, Ohio. A new 50-ton crane and runway will be installed, according to W. F. Parker, president.

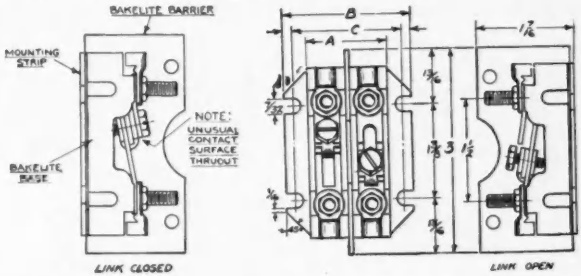
STATES TESTING EQUIPMENT

2 IN 1

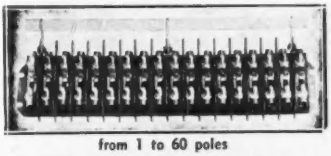
TYPE NT SLIDING LINK TERMINAL BLOCKS

Are Test Blocks Too

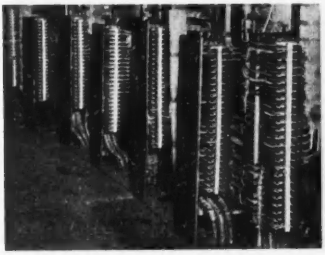
A good way to terminate wires, and an easy way to check circuits without disturbing permanent wiring.



States Type NT Blocks can be obtained in any number of poles to 60, front or back connected, with or without cover, with or without marking or coding strip.



from 1 to 60 poles



Here is an excellent method for terminating incoming cables and panel connections. Type NT Blocks may be placed in any position they seem to best fit. They fit into out of the way places when you are cramped for space. (See cut to the right.) For complete information see Cat. 1 Sec. 6.

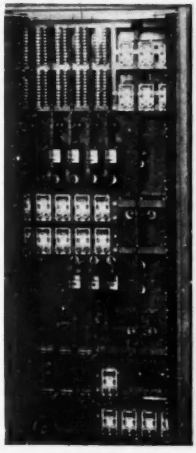
CHECK the FACTS

Any number of poles through 60.

Simplicity of coding and testing crowded circuits.

Operated with screw driver or a hex wrench. No parts to remove.

Excellent for Relay Circuits, Signal, and Intercommunication circuits, fire alarm circuits, etc.

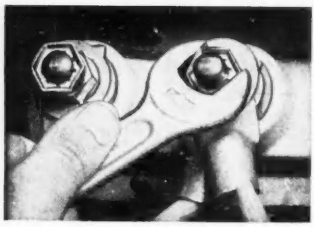


. . . . Tear off & Mail to . . . .

THE STATES COMPANY,
3 New Park Ave., Hartford, Conn.
Please send copy of Cat. 1 Sec. 6

Name ..... Title .....
Firm .....
City ..... State .....

PALNUTS* Keep Terminal connections Permanently Tight



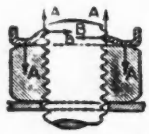
- *Perfect Conductivity*
- *No heating or corroding of contact surfaces*
- *Easy, speedy assembly*

PALNUTS apply on TOP of the regular nuts, holding them to original tightness. Spring washers are eliminated between nut and terminal lug. There can be no backing off of nuts, nor opened spring washers to reduce contact. Instead, full conductivity of the entire nut seat is maintained under severest vibration.

Double-locking PALNUTS are single thread locknuts, made of tempered spring steel or silicon bronze. They are easily, quickly spun on with the fingers and locked with 1/3 turn of a wrench. Require only 3 bolt threads space, are light in weight, low in cost, may be re-used.

PALNUTS are available from stock for every utility requirement. Write for PALNUT Manual giving engineering data.

Double Locking Action



Arched, slotted jaws grip the bolt like a chuck (B-B), while spring tension is exerted upward on the bolt threads and downward on the regular nut (A-A), securely locking both.

** Trademark, Reg. U. S. Pat. Off.*

THE PALNUT COMPANY

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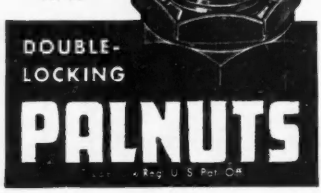
Irvington 11,
N. J.



NEW ELECTRICAL CONSTRUCTION

A weekly selection of U. S. electrical construction projects announced by private and government utility systems involving more than $70,000. Also listed are major industrial and construction jobs where electrical work is indicated or implied

UTILITIES

Proposed Construction

Alabama—Baldwin Co. Electric Membership Corp., Robertsdale, 90 mi. rural distr. line, sys. imprvs., headquarters facilities and 2 way radio communication sys. Baldwin Co. **$280,000.**

Arizona—Bureau Reclamation, Dpt. Interior, Denver Federal Center, Bldg. 1-A, Denver, Colo., control center, lighting distr. panel board, power distr. panel boards, and cabinet, transformers, for Davis Power Plant, Davis Dam Proj., Spec. 2638. L. N. McClellan, ch. engr.

Arkansas—Riceland Electric Co-operative, Stuttgart, 157 mi. rural distr. lines, sys. imprvs, warehouse facilities, two-way radio communication sys. and completion of previously approved constr., Arkansas Co. **$370,000.**

Georgia—Blue Ridge Electric Assn., Young Harris, 150 mi. rural distr. line, sys. imprvs., and completed constr. with prior REA approval, Towns Co. **$355,000.**

Ia., Forest City—City, Forest City-municipal light & Power plant extens., Sect. 1, diesel generating units and auxiliaries; Sect. 2, bldg. constr. and imprvs. plant bldg.; Sect. 3, electrical work incl. switchboard, bus structure, new feeding cable and wiring. Over $70,000. Stanley Eng. Co., Hershey Bldg., Muscatine, engr.

Kansas—Victory Electric Co-operative Assn., Dodge City, 358 mi. rural distr. lines, sys. imprvs., 15 mi. new tie lines, two-way radio communication sys., Ford Co. **$496,000.**

Missouri—Laclede Electric Co-operative, Lebanon, 217.5 mi. rural distr. lines, Camden, Pulaski, Dallas, Laclede and Wright Counties, and conversion of 3.5 mi. of lines, $225,000. Frank Horton & Co., Lamar, engrs.

Neb., Blair—City, power plant imprvs., incl. power piping, power wiring, bldg. constr. $70,000. Black & Veatch, 4706 Broadway, Kansas City, Mo., engrs.

N. M., Hot Springs—Bureau Reclamation, Dpt. Interior, Bldg. 1-A, Denver, Federal Center, Denver, Colo., 110,000/2,400 volt, 3,000 kva package type substation equip. for Hot Springs Substation, Rio Grande Proj. Texas-Mexico. Approx $100,000.

N. Y., New York—Consolidated Edison Co. of New York, 4 Irving Pl., electric generating station alterations at E. 138 St. and Locust Ave. $700,000.

Oklahoma—Southwestern Power Admin., P. O. Drawer 1619, Tulsa, Zone 1.

Caddo Co.—78 mi. 66 kv. electric transmission line from Lindsay to Anadarko. **$730,000.**

Carter Co.—46 mi. 66 kv. electric transmission line from Ardmore to Marietta. **$188,000.**

Garvin Co.—138 mi. 132 kv. electric transmission line from Lulu to Lindsay. **$1,124,200.**

Johnston Co.—70 66 kv. electric transmission line from Russett to Tishomingo. **$206,800.**

47 mi. 66 kv. electric transmission line from Tishomingo to Conneville. **$155,100.**

Marshall Co.—52 mi. 66 kv. electric transmission line from Russett to Madill. **$94,000.**

Murray Co.—72 mi. 66 kv. electric transmission line from Connerville to Sulphur. **$207,000.**

Okemah Co.—42 mi. 66 kv. electric transmission line from Okemah to Prague. **$206,800.**

Okfuskee Co.—27 mi. 66 kv. electric transmission line from Okemah to Weleetka. **$155,100.**

Seminole Co.—38 mi. 66 kv. electric transmission line from Seminole to Tecumseh. **$156,000.**

Sequoyah Co.—54 mi. 66 kv. electric transmission line from Gore to Webber Falls. **$196,000.**

Stephens Co.—118 mi. 66 kv. electric transmission line from Comanche to Lindsay. **$517,000.**

Okla., Anadarko—Southwestern Power Admin., P.O. Drawer 1619 Tulsa, Zone 1, 66 kv. electric substation. **$395,880.**

Okla., Fort Gibson — Southwestern Power Admin., P.O. Drawer 1619, Tulsa, Zone 1, 66 kv. electric substation. **$590,400.**

Okla., Lulu—Southwestern Power Admin., P.O. Drawer 1619, Tulsa, Zone 1, substation. **$153,000.**

Okla., Walters — Southwestern Power Admin., P.O. Drawer 1619, Tulsa, Zone 1, substation. **$117,210.**

Okla., Webber Falls — Southwestern Power Admin., P.O. Drawer 1619, Tulsa, Zone 1, 66 kv. electric substation. **$401,000.**

Okla., Weleetka—Southwestern Power Admin., P.O. Drawer 1619, Tulsa, Zone 1, 66 kv. electric substation. **$161,000.**

Texas—U. S. Eng., 606 Santa Fe Bldg., Galveston, transformers, appurtenances for Whitney Dam Power Plant, on Brazos River near Hillsboro, Hill Co., Inv. No. Eng-41-243-49-257.

Texas—Houston County Electric Co-operative, Crockett, addnl. rural distr. lines, sys. imprvs., Houston Co. **$450,000.**

Tex., Dallas — Lacy-Potter Television, 1519½ Commerce St., 377 ft. steel television tower, 8'8x8 ft. studio, etc. (call letters KDTV). $200,000. Fooshee & Cheek, 1901¼ N. Harwood St., archts.

Virginia—U. S. Eng., foot of Front St., Norfolk, two 1,250 kva alternating-current generators, Buggs Island Powerhouse, Serial No. Eng-44-110-49-169.

Washington—Pub. Wks. Office, Puget Sound Naval Shipyard, Bremerton, 115-kv pole line and change in primary service for Substation G, U. S. Naval Base; steel sheet piling wall 210 ft. long, with dredging, gravel backfill and concrete work, for caisson seat, Drydock 3, Pudget Sound Naval Shipyard, for Yards and Docks Annex, Navy Dept., Arlington, Va.

Low Bidders & Contracts Awarded

Minnesota—P.K.M. Electric Co-operative, Warren, Mar. 29, 748 mi. rural distr. lines, Polk, Kittson and Marshall Counties, from Delta Constr. Co., Clarksdale, Miss., **$873,229.**

Washington—Bonneville Power Admin., 729 N. E. Oregon St., Portland 8, Ore., 34 mi. Foster Creek-Columbia River sect. & Foster Creek-Snohomish 230 kv transmission line, Inv. 4503, Douglas Co., from Smith & White, Vancouver, **$374,450.**

INDUSTRIAL, COMMERCIAL & PUBLIC BUILDINGS

Proposed Construction

Tex., Houston—University of Texas, c/o Bd. Regents, Austin, plans by MacKie & Kamrath, 2713 Ferndale St., and Schmidt, Garden & Erickson, 104 S. Michigan St., Chicago, Ill., cancer research **$2,000,000,** dental school **$2,000,000;** plans by R. L. White, c/o owner, university archt., preceptorial training center **$1,150,000,** public health school **$1,100,000;** plans by MacKie & Kamrath, 2713 Ferndale St., Negro Medical and Dental School **$750,000,** for Texas Medical Center, M.D. Anderson Hospital for Cancer Research, 2310 Baldwin St.

Low Bidders & Contracts Awarded

Ore., Portland—Carl M. Frantz & John F. Haviland, 1123 S.W. 5 St., 12 story, 212 unit rein.-con. apartment, to Reimers & Jollvette, Builders Exchange Bldg., **$2,000,000.**

RECENT RATE CHANGES

Long Island Lighting Co has been ordered by the New York Public Service Commission to reduce electric rates for customers in most of Nassau and Suffolk Counties and parts of Queens. The new schedule became effective Apr 1. At the same time the company was authorized to increase gas rates $770,000 a year. The electric rate reduction will amount to a decrease of 5.6% in customers' bills, except for water heating, which already carries a low rate. In addition to Long Island Lighting, other companies affected include its subsidiaries, the Queens Borough Gas & Electric Co and the Nassau & Suffolk Lighting Co.

Consolidated Gas Electric Light & Power Co of Baltimore has been permitted a temporary increase of 11½% in electric, gas, and steam rates by the state Public Service Commission. The increase is designed to produce about $7,100,000 in additional revenues annually. It will become effective with the May meter readings and will continue in force until permanent rates are prescribed. The board held that the company is entitled to a fair return.

Philadelphia Electric Co's new tariff filed with the state Public Utility Commission, increasing gross revenues an estimated $9,587,541 annually, became effective Apr 18. The PUC took no action to prevent the increased rates from becoming effective on that date. Filed last Feb 15, the tariff would affect all of the company's 856,365 customers in Philadelphia, Delaware, Bucks, Chester, and Montgomery counties. The tariff is the first filed by the company for an increase since 1921. The increase will average approximately 45 cents a month to the residential customer, with the major portion of the increase reflected in charges to the utility's commercial, industrial, and miscellaneous customers. Bills of the Philadelphia Division residential users will be increased $2,078,810 a year, and those of the Suburban Division $1,437,630 annually. Under the proposed tariff, the Philadelphia Division residential rate would provide for a minimum of $1 for the first 14 kwhr, with 5¢ for each of the next 25 kwhr; 3¢ for each of the next 36 kwhr, and 1.8¢ for each kwhr of additional use. The minimum charge would be $1 a month. The residential rate in the Suburban Division would be $1 for the first 12 kwhr; 5¢ for each of the next 44 kwhr; 3¢ for each of the next 44 kwhr; and 2¢ for each additional kwhr. Off-peak water heating rates would be one cent per kwhr with a minimum charge of $1.12 a month. Industrial, commercial, professional, and other users outside the scope of residential service would pay $1.12 per kwhr for the first 10 kwhr of the billing demand, but not less than 10 kwhr; 1.6¢ for each of the next 80 kwhr, but not less than 150 kwhr, and 1.1¢ per kwhr for additional use.

Jersey Central Power & Light Co has announced voluntary withdrawal of its application for increased electric rates (EW, Mar 12, p 188.) E. H. Werner, president, said the action does not affect the utility's application before the State Board of Public Utility Commissioners for an increase in gas rates. Mr Werner said the application was withdrawn because the first two months of 1949 showed considerable improvement over conditions at the end of 1948.

Case History*

of

Untreated versus Treated

Poles

1925	1946
51 Untreated Poles Placed (Northern White Cedar)	. . . 19 Poles Still Serviceable
607 Treated Poles Placed (Southern Pine)	. . . 600 Poles Still Serviceable

AND *Creosote* MADE THE DIFFERENCE!

In 1946, after 21 years in line—600 out of 607 Pressure-Creosoted Poles were still serviceable. And of the 7 poles no longer in service, 5 had been removed because of a grade crossing clearance—2 because of an accident. *Not a single one* of the 607 poles had been removed because of deterioration due to treatment or preservative failure—a 100% record for creosote.

And when it comes to creosote, you get the best possible delivery service from Koppers. With 14 creosote-producing plants—with 4 large storage plants—Koppers can supply you with creosote *where* you need it—*when* you need it.

Koppers is the nation's largest distributor of creosote. So remember—you can always count on Koppers to help you maintain your production schedules.

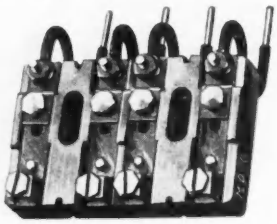
KOPPERS COMPANY, INC. · Pittsburgh 19, Pa.

*Proceedings of the American Wood Preservers' Association—1947.

All Standard Specifications
For All Types of Wood Preservation

KOPPERS CREOSOTE...*to be sure!*

Patented SLIDE-A-LINK TEST BLOCKS give twice the capacity at the bolted contact. Made in every size and style for any need. Removable solderless lugs or meter loops on all terminals.



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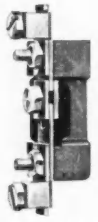

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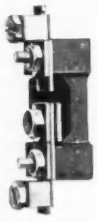
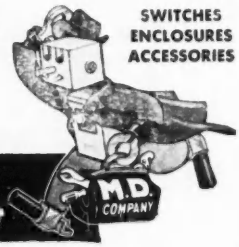


Section View Showing Link in Open Position.

We work with YOU in designing and supplying electrical metering devices and methods. Write for bulletins on Meter or Relay Test Switches, Accessories and Metal Indoor or Outdoor Enclosures.



SWITCHES
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METER DEVICES
COMPANY • CANTON, OHIO

Specify National
INSULATING MATERIALS
For Long Life and Reliability

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Cements
Compounds
Enamels
Fabrics
Fiberglas
Laminates
Mica Products
Papers, Fibres
Silicones
Sleevings
Tapes
Tubings
Varnishes

If you have a *special* electrical insulation problem — heat, moisture, oil, acid, etc. — which causes persistent trouble — *that's* where we shine. For years and years we have studied the problems of the man who has more than the ordinary insulation problem. We have found ways to lengthen insulation life under adverse conditions. We developed Mica-Glas, all-inorganic. We were among the first to apply the advantages of silicone to insulation. Then, to bring such experience to you we placed factory-trained engineers in the field. One is near you *now*, waiting not just to sell insulation but to help you profit by its use. Use him. Tell him your problem. He's equipped to solve insulation problems, and that's his job. Call him in; if you don't know him, write or wire us.

NATIONAL ELECTRIC COIL COMPANY
COLUMBUS 16, OHIO, U. S. A.
ELECTRICAL ENGINEERS MAKERS OF ELECTRICAL COILS AND INSULATION — REDESIGNING AND REPAIRING OF ROTATING ELECTRICAL MACHINES
TRADE MARK

TECHNICAL LITERATURE

Lap Cracks—*Cause and Prevention of Lap Cracks in Steam Boilers* is a report of tests conducted by Mutual Boiler Insurance Co of Boston. The 8-page publication may be obtained from the Engineering Dept of that company at 60 Batterymarch St, Boston 10, Mass.

Stainless Steel—Characteristics of stainless steel and recommended procedures for fabrication, welding, etc. are presented in concise form in TEMPIL TOPICS No. 10, issued by Tempil Corp, 132 W. 22nd St, New York 11, N. Y.

Letter Symbols—The *American Standard Letter Symbol for Physics*, designated Z10.6-1948, has been issued by the American Standards Association, 70 E. 45th St, New York 17, N. Y., price $1 per copy. Common terms in elementary physics and some in advanced physics and related fields are included.

Capacitors—*NEMA Standards for Series Capacitors*, Publication 48-135, covers rating, manufacturing and testing of capacitor units rated ½ kva and larger for series connection in low-frequency a-c circuits. Copies at $1.50 each are available from National Electrical Manufacturers Association, 155 E. 44th St, New York 17, N. Y.

Chlorophenyls—Physical properties and suggested applications of the Aroclors, chlorinated biphenyl and chlorinated polyphenyls, applicable in the electrical insulating field, are contained in Bulletin P-115 issued by Monsanto Chemical Co, St. Louis 4, Mo.

Printed Circuits — *New Advances in Printed Circuits* is a published proceedings of a symposium held under the supervision of National Bureau of Standards. Known as NBS Miscellaneous Publication M192, the book contains 18 chapters, 73 two-column pages, 43 illustrations and 6 tables. It is available at 40¢ per copy from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

Cable Failures — *Recommended Procedure for the Diagnosis of Cable, Joint and Termination Failures* is publication Q-7 issued by Edison Electric Institute, 420 Lexington Ave, New York 17, N. Y., price 75¢ per copy to non-members in the United States.

Gas Turbines—*Definitions for Marine-Propulsion Gas Turbines* is Publication 48-134 released by National Electrical Manufacturers Association, 155 E. 44th St, New York 17, N. Y., price $1.25 per copy.

Laminated Sheets — Standard grades, thicknesses, tolerances, tests and technique for applying are contained in *Standards for Laminated Thermo-setting Decorative Sheets*, Publication 48-136. The 8½x11-in. pamphlet may be obtained, at 80¢ per copy, from National Electrical Manufacturers Association, 155 E. 44th St, New York 17, N. Y.

Solder—A 28-page manual *Solder and Soldering Technique* provides an analysis of the properties and application of soft solder alloys and soldering fluxes. Copies may be obtained from Kester Solder Co, Technical Dept, 4201 Wrightwood Ave, Chicago 39, Ill.

Piping Materials—The sixth edition of *ASTM Specifications for Steel Piping Materials* includes 50 specifications on pipe, tubes, castings, forgings, bolting. The 330-page book can be obtained at $3 each from American Society for Testing Materials, 1916 Race St, Philadelphia 3, Pa.

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● BATTERIES: A 16-page catalog illustrates the various types of Gould stationary batteries, giving the engineering specifications of each type. Gould Storage Battery Corp, Trenton 7, New Jersey.

● RHEOSTATS: Contained in Bulletin 41-9 are descriptions of the various styles of standard, screw-drive, double, graded, switchboard, metal-caged and non-inductive rheostats. "How to Select" is explained for the various applications of rheostats. James G. Biddle Co, 1316 Arch St, Philadelphia 7, Pa.

● PUMPS: Bulletin W-319-BIC describes and illustrates high-pressure, high-temperature centrifugal boiler-feed pumps, and includes a historical survey of these installations. Worthington Pump & Machinery Corp, Harrison, N. J.

● THERMOCOUPLES: A 40-page manual Bulletin T/C 7 provides information on selection of proper thermocouples and protecting tubes, methods of checking thermocouples and pyrometers and installation data. Wheelco Instruments Co, 847 West Harrison St, Chicago 7, Ill.

●GAGES: Descriptions of indicating and recording pressure gages, recording flow meter and pressure gage, air-operated controller, non-indicating pressure controllers, indicating furnace pressure controller, and precision pressure regulator are given in Catalog 7000, entitled "Pressure and Vacuum Gages." Brown Instrument Co, Wayne & Roberts Aves, Philadelphia 44, Pa.

●RECLOSERS: Performance, economy and service features of automatic circuit reclosers are described in Bulletin 1371. This 12-page publication gives the application, operation details and installation data. It contains also characteristic time-current curves for Type MB and MBH reclosers, 60, 100, 160, 200 and 250 amp. Railway & Industrial Engineering Co, Greensburg, Pa.

●WELDING ACCESSORIES: New 12-page catalog, Form No. 7, illustrates a line of electrode holders, ground clamps, cable connectors, cable splicers, terminal connectors, cable lugs and carbon electrode holders. The booklet contains information about the maintenance and care of these products. Tweco Products Co, P. O. Box 666, Wichita 1, Kans.

●GEAR-MOTORS: In a brochure 3-200, Type UW gear-motor is described. The booklet illustrates foot and flange mounting of this unit and includes complete dimensions, assembly positions, and a tabulation listing torques, speeds, gear ratios and overhung load capacity. Janette Manufacturing Co, 556 W. Monroe St, Chicago 6, Ill.

●ANODES: An 8-page brochure briefly shows many of the types of corrosion which anodes will combat and illustrates the many varieties of magnesium anodes available. Aluminum Co of America, 230 Park Ave, New York 17, N. Y.

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BOOK REVIEWS

Handbook of Industrial Electronic Circuits. By John Markus and Vin Zeluff. Published by McGraw-Hill Book Co, Inc New York 18. 272 pages, illustrated. Price $6.50.

Over 430 circuits in full detail are classified and so labeled and indexed that the reader should be able to locate practically any combinations he would be likely to search for. These are all from authentic literature (mostly Electronics) and therefore subjected to editorial analysis and their readers' application. Titles have been changed from the original to facilitate identification with the desired function. Items are arranged under the following categories; audio-frequency, capacitance control, cathode-ray, control and counting, electronic switching, limiters, measurement, metal location, motor control, multivibrators, oscillators, photoelectric, power supply, stroboscopic, telemetering, temperature control, timing, ultrasonic, voltage regulators and welding controls. Industrial engineers and their utility power sales advisers should find these circuits a stimulus to overcoming whatever reluctance either have to "doing it better electronically".

An American Engineer in Afghanistan. By Marjorie J. Bell. Published by University of Minnesota Press, Minneapolis. 335 pages, illustrated. Price $5.

Engineers, even electrical engineers, are proverbially poor writers. But here is a gratifying exception. A. C. Jewett pioneered the street railways in San Francisco, the earliest transmission in California and the first San Joaquin installation. As General Electric engineer he installed electric systems in India and Brazil before being commissioned to install a 1,500-kw hydro plant at Jabal-us-Siraj and run a 44-kv line 42 miles to Kabul, the capital of Afghanistan. He arrived there in May 1911 and these are his letters to his niece during the six and one-half years before the plant was in operation. They form an exciting and colorful recital of his leisurely dealings with the Sultan, the indolence and thievery of the workers, the living and travel customs of the populace and the discouraging efforts to get material delivered and installed. It constitutes a keen, picturesque view of life in a backward country for an engineer eager to modernize and then return home. Engineering details are pleasurably few but men of power will be intrigued by the four cents per yard cost of moving earth and the 46 cents per tower cost of erection (six men put up two a day). The book is a "must" for engineers disposed to think that engagements in foreign countries cannot be discomfitting as well as entrancing. Incidentally the only publications Jewett received with any regularity were ELECTRICAL WORLD and *Life* (then a comic).

Floods, Their Hydrology and Control. By H. K. Barrows. Published by McGraw-Hill Book Co, Inc, New York 18, N. Y. 432 pages, illustrated. Price $6.50.

Data about rainfall, runoff, flood crests and frequency are here in profuse quantity about practically all the streams of the nation. It has the hydraulic formulas, practical coefficients and chart techniques for analysis and prediction, including the effect of storage reservoirs and power reservoirs coordinated for flood routing and control. Of course there is ample discussion of gauging, spillways, revetments, etc. Thus the power-pool operation and interconnection dispatcher will find here the information and the process of the hydrologist. The author seems to have generous faith in the concept of the multipurpose dam when designed for the purpose. The index is scanty on such items as units and obscure hydrologic terms.

New Advances in Printed Circuits. By National Bureau of Standards. 73 pages, illustrated. Obtainable from Supt. of Documents, Washington. Price 40¢.

The papers embraced here are those presented by government and industrial engineers at a symposium aimed primarily toward serving aeronautical needs. However, electrical engineers in industrial and utility plants will be running into more and more printed circuits as they extend their electronic applications. The papers tell not only of the multifarious processes but of the increasing range of applications. Resistors, inductors and capacitors are being printed as well as the connecting conductors. Ask for NBS Miscellaneous Publication 192.

English-French and French-English Technical Dictionary. By Francis Gusset. Published by Chemical Publishing Co., Inc., Brooklyn, N. Y. 590 pages. Price $5.00

Some 15,000 technical words and phrases are indicated in terms of their equivalents in both directions. These pertain to basic physical science, mechanics, chemistry, Metallurgy, mining and electricity. It appears that about one-tenth are terms and expressions used exclusively by electrical engineers and this covers a fair cross-section of such vocabulary. A distinctive feature is the inclusion of more or less idiomatic technical phrases which are the stumbling block for the translator who tries the word-at-a-time conversion. Metric equivalents are given in eight pages of tables in an appendix.

Components Handbook. By J. F. Blackburn. Published by McGraw-Hill Book Co, New York 18. 626 pages, illustrated. Price $8.

Unique thus far among the MIT Radiation Laboratory Series this volume is truly a handbook rather than a theory text. It is further unique in that it compiles information about electronic components in form useful for any frequency and not merely the h.f. and radar applications. Many a designer and experimenter in conventional radio and carrier brackets should welcome the practical data about conductors, resistors, inductors, transformers, delay circuits, potentiometers, variable condensers (fixed condensers omitted), instrument motors, power supplies, relays and, last but not least, receiving tubes. Characteristics, ranges, ratings and commercial forms are recorded or tabulated in detail.

LETTERS TO THE EDITOR

Net Income and Profit

To the Editor of ELECTRICAL WORLD:

I have just been able to take a few minutes to glance through the Annual Statistical Issue of ELECTRICAL WORLD covering the operations of the central station industry for the year 1948. These annual issues constitute a real service to those of us who have something to do in one way or another with the industry. My congratulations to you and your associates on a particularly well set-up number.

I know you will accept in the spirit in which I mean them some comments I feel impelled to offer concerning terminology appearing therein.

On page 118 in the third column about two-thirds of the way down I note the term 'net profit.' This obviously refers to net income as defined in the system of accounts. I have long considered that the word 'profit' has no place in the terminology applicable to the utility business. If, conceivably, it has a place it is with respect to that component of income, if any, which may exceed a reasonable return and, therefore, if any profit exists it indicates either a temporary condition or a failure of the regulatory process. A few lines lower I find the expression "rate of return on sales". This to me is a new usage of the term 'rate of return'. Perhaps it is not improper as used in the ELECTRICAL WORLD, but the expression definitely has a characteristic meaning to those of us in regulation and I think to most of our associates in utility operation. It should mean only one thing and this is the percentage relationship between an amount of return and a rate base. Reading a few lines further I find the term "fixed capital". This term is well nigh obsolete. Personally I like it because the alternative is longer—'investment in utility plant.' In the bottom line I find the term "gross plant." I think a better term would have been "electric plant account".

Referring to the table relating residential service appearing on page 115 I get a lot of satisfaction out of the comparison of one of our New Jersey companies with the national averages. By combining aggressive management, a competent sales force and favorable rates under the New Jersey Automatic Rate Adjustment Plan, New Jersey Power & Light Company has done considerably better than the national average with respect to kwhr per customer and when it is considered that practically all the energy is steam-

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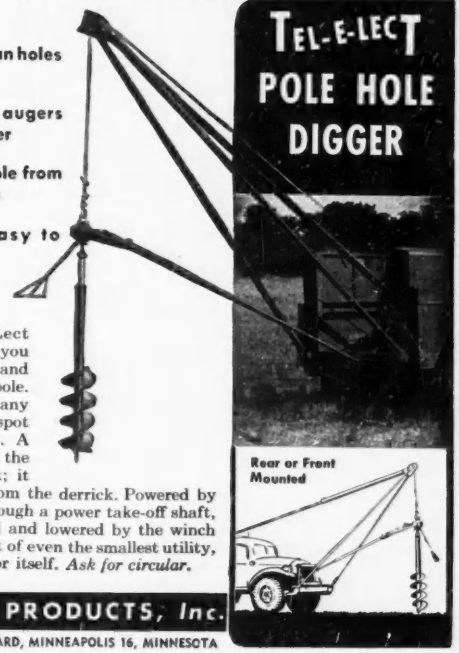

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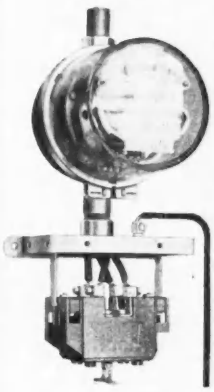

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H. J. Flagg.
Executive Officer, Board of Public Utility Commissioners, New Jersey

Industrial Welding Load

To the Editor of ELECTRIC WORLD:

Here are a few thoughts to supplement your editorial on industrial welding on page 88 of your January 29 issue.

I think it should be pointed out that welding systems having a low kva demand may be economically sound where there is only one or at the most a very limited number of them in a place where power supply is a problem. However, there will be many other possible applications where there are enough welders so the general diversity of load on the system is such that it is completely uneconomical to supply the more expensive converter systems. In these cases, it may be more economical to correct the power factor for the whole plant by means of shunt capacitors or a synchronous motor, or in some cases it may be even more economical to run in an adequate power supply system.

It is my feeling that there may be a tendency to overemphasize the importance of the low kva demand of these low frequency systems. I am inclined to think that we still do not comprehend the real importance of the low frequency and rectifier systems which may well be in their weldability rather than in their improvement of the power supply problem.

E. H. Vedder, Chairman AIEE Electric Welding Committee and Manager, Electronic Control Engineering, Westinghouse Electric Corp

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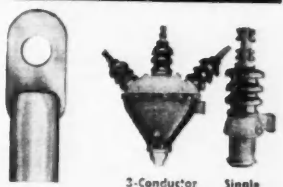
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P-8615, Electrical World
330 West 42nd St., New York 18, N. Y.

WANTED
SALES ENGINEERS

Manufacturer of electrical transmission and distribution equipment offers exceptional opportunity to E. E. graduates under 45 with at least 4 years sales experience. Excellent starting salary. Good yearly bonus. Travel expenses. Participation in Profit Sharing Plan after 3 years. Positions are permanent and offer definite opportunity for advancement. Submit full particulars.

P-8316, Electrical World
520 N. Michigan Ave., Chicago 11, Ill.

REPLIES (Box No.): Address to office nearest you
NEW YORK: 330 W. 42nd St. (18)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

ELECTRICAL ENGINEER with mature experience on Electrical Engineering and Design of Steam and Hydro Generating Stations. Position as Project Engineer. Location New York City. P 8501, Electrical World.

ELECTRICAL ENGINEERS with some experience in substation and power plant design. Pleasant working conditions. Location in ideal home community. Write Electrical Engineer, Pennsylvania Power & Light Company, Allentown, Pa.

OPENING AVAILABLE for local manager of small electric utility in Rocky Mountain area. No generation. Must be experienced in distribution operation, substations, metering, and public relations. Write full particulars. P 8635, Electrical World.

SELLING OPPORTUNITIES OFFERED

ESTABLISHED 38 year manufacturer promoting new line of electrical appliances, receiving amazing acceptance, desires salesmen to introduce line to jobbers and do missionary work with jobber salesmen. Substantial salary plus expenses. Excellent future. Midwest, Southwest and Southeast protected territories open. Compensation while training. Enclose recent photo with application. SW 8530, Electrical World.

EMPLOYMENT SERVICES

SALARIED POSITIONS $3,500-$35,000. If you are considering a new connection communicate with the undersigned. We offer the original personal employment service (39 years recognized standing and reputation). The procedure is highest ethical standards, is individualized to your personal requirements and develops overtures without initiative on your part. Your identity covered and present positions protected. Send only name and address for details. R. W. Bixby, Inc., 262 Dun Bldg., Buffalo 2, N. Y.

POSITIONS WANTED

METERMAN: AGE 41. Thirteen years experience planning, installation, testing and maintenance, all types of metering equipment. Fully qualified best references, presently employed. Interested in new connection. Will go anywhere. Address PW 8617, Electrical World.

(Continued on opposite page)

SEARCHLIGHT SECTION

WANTED

SALES MANAGER for LARGE DIESEL GENERATORS

Appointment available for competent engineer to serve as sales manager for diesel division of established, well-known organization on West coast. Man should have versatility and ability to organize sales agencies. Also, good knowledge of public utility and industrial power fields. Permanent position, good salary. Write

SW-8598, Electrical World
68 Post St., San Francisco 4, Calif.

WANTED

ESTABLISHED ENGINEERING FIRMS — SALES AGENCIES FOR LARGE DIESEL GENERATING PLANTS

Reputable, established company needs territorial sales agencies. Applicants must be thoroughly reliable, long standing, familiar with municipal, central station, and other power requirements. Write

RW-8597, Electrical World
68 Post St., San Francisco 4, Calif.

POSITIONS WANTED

ELECTRICAL ENGINEERING graduate, May 1949, Missouri School of Mines and Metallurgy. Interested in electrical equipment manufacturing. 2½ years machine shop inspection experience. Age 25, single, veteran. PW 8644, Electrical World.

POSITION AS Meter Superintendent. Have had 30 years experience with two large manufacturers and two utilities. Small community preferred. PW 8708, Electrical World.

ELECTRICAL ENGINEER, 29, both EE and ME degrees,2 years Army, 6 years diversified industrial experience, excellent writer and public speaker, desires position as sales or application engineer for manufacturer of electrical equipment. Resume and photo on request. PW 8684, Electrical World.

GRADUATE ELECTRICAL Engineer, age 52. Of over 25 years of wide experience in general maintenance, construction, installation, testing, inspecting, layout, designing, power plants, sub-stations, plant equipments, power, lighting, distribution and plant surveys. PW 8711, Electrical World.

SALES ENGINEER Aggressive young man desires position on West Coast as Sales Engineer with manufacturer in Electrical Field. Age-26-married-graduate, U. S. Merchant Marine Academy, N. Y. Licensed Marine Engineer. PW 8734, Electrical World.

NEW ADVERTISEMENTS

Copy must be received by April 29th to appear in the May 7th issue.

FOR SALE

HYDRO-ELECTRIC UTILITY and 200 ACRES SITE—

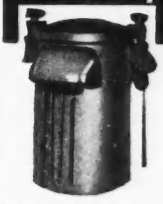
with FRANCHISE-EASEMENTS-RIGHT-OF-WAYS serves Rexford Montana

$12,000.00

A one man job—Must sell, poor health

W. V. KUCHAN, *owner*
REXFORD, MONTANA

SEND your TRANSFORMERS to ELECTRIC SERVICE CO., INC.



A financially responsible organization specializing in buying, selling, repairing, rewinding and redesigning transformers only.

Experienced personnel assures you first class workmanship and complete satisfaction.

Every transformer guaranteed for one year

The Electric Service Co., Inc.
"AMERICA'S USED TRANSFORMER CLEARING HOUSE"
MARIEMONT Since 1912 CINCINNATI 27, OHIO

J. L. HEMPHILL & CO.

ELECTRICAL ENGINEERS & EQUIPMENT

1606 53rd ST., NORTH BERGEN, N. J. N. Y. C. Tel.: LOngacre 5-3227 N. J. Tel. UNion 3-2530

MOTORS SQ. CAGE

1—450 HP.—Ridgeway 900 rpm 2200v.
1—125 HP. G.E., 1800 rpm 2300v.
1—100 HP. Whse., 1800 rpm 440v.
1—100 HP. Whse. 1200 rpm 2200-440v.
1— 75 HP. Whse. CS, 1200 rpm, 2200 volts, 3 phase, 60 cycle.
1—75 HP. 1800 rpm Westinghouse, 440 volt.
1—75 HP. General Electric Type KT 900 RPM 440 volt.
2—40 HP. G.E., 900 rpm 220v.
40/20 HP Westinghouse 600/450 44 volt

MOTORS SLIP RING

1—2500 HP G.E. MT 257 RPM 6600 volt
2— 150 HP G.E. Type IM 450 RPM 440 volt.
1— 100 HP G.E. Type IM 400 RPM 440 volt.
1— 100 HP G.E. 720 rpm 440v, 25 cy. IM.
75 HP. G.E. 1200 rpm 220v, 60 cy. Vert.
60 HP. West. 900 rpm 2200v, 60 cy. Vert.
50 HP. F.&M. 1800 rpm 220v, 60 cy.

MOTORS—D. C. 230 VOLTS

1—125 HP. G.E. 1800 rpm R.C.
1— 75 HP. 865 rpm General Electric
1— 50 HP. 884 rpm Crocker-Wheeler.

VARIABLE SPEED—220 VOLTS

1—35 HP. 300/1200 rpm Westinghouse.
1—30 HP. 440/1200 rpm General Electric.
2—25 HP. 650/2200 rpm Westinghouse.
2—25 HP. 300/900 rpm Electric Dynamic.
1—55 HP. 500/1500 rpm General Electric.

MOTOR GEN. SETS

1—1000 KW Westinghouse 275 volt, 720 RPM 4000 volt Syn.
1—1000 KW General Electric 600 volt 514 RPM 4000 Volt Syn.
1—500 KW. G.E. 250v 900 rpm 2300v Syn.
1—500 KW. G.E. 575v 900 rpm 2300v Syn.
1—125 KW. Crocker Wheeler 1200 rpm 125v Generator 2200v S.C. Motor.
1—100 KW. Elect. Mach. 1200 rpm 125v Generator 4150 Syn. Motor.

PLATING GENERATORS

1—1½ KW. G.E. 5/6v with sq. cage mt.
1—12 KW. Hansen Van Winkle 24v 1200 rpm. 20 HP. General Electric KF Motor.
1—3000 Amp. Chandeysson, 6/12v 400 rpm Syn. Motor.
1—2500 Amp. ditto.
1—625 KVA West. Reduction Gear Turbo Generator Non-Condensing, 2400v 3 ph 60 cy.

TRANSFORMERS

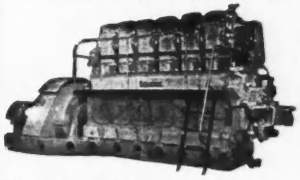
1—1000 KVA G.E. 3 ph. 4150 volt to 2400 volt.
3—400 KVA G.E. 6900 v. pri. 2300 v. sec.
3—400 KVA, G. E. 6900 V. Pri.—2300 V. Sec.
3—300 KVA Pitts. 2300v pri. 115/230v sec.
2—300 KVA G.E. type H 2300v pri. 115/230v sec.
3—150 KVA West. 2300 volt Pri. 240/480 sec.
1—150 KVA G.E. 2300v 110-220v.
3—75 KVA American 2400 volt primary 240/480 secondary.
6—50 KVA West. 2300 v. 120/240 v. Inerteen

ALTERNATORS & SYNCH. MOTORS

1—2500 KVA Westinghouse, Syn. condenser, 720 rpm 2200v with D.C. exciter.
1—320 KVA Allis Chalmers, 450 rpm 480v.
1—240 KVA General Electric ATB, 600 rpm 240v with D.C. exciter.
1—225 KVA 514 rpm 600v Westinghouse.
4—200/100 HP. Whse. 720/360 rpm 4150v.
1—200 HP General Electric 257 RPM 448 volt.
1—100 HP. G.E. type TS 600 rpm 440v D.C.
2—150 HP. Allis Chalmers, 860 RPM, 2300 volt

Complete Line of A.C. and D.C. Motors and Generators

ENTERPRISE DIESELS



Quan.	HP	Model	RPM	KW	
*2	450	Enterprise DSG-6	450	300	AC
*2	450	Enterprise DSG-6	450	300	DC
2	1600	General Motors 16-278A	720	1250	AC
1	450	Fairbanks Morse 32-E-14	300	300	AC
1	385	Ingersoll Rand "S"	600	250	DC
*2	240	Buckeye 80	600	160	AC
*2	90	General Motors 6016-E	1200	60	AC
*2	90	General Motors 6-71	1200	60	DC

*—new.

DIESEL MOTORS CORP.
Port Washington, N. Y.
Port Washington 7-2000

TURBO GENERATORS

1—4000 KW G.E. Auto Extraction 250 lbs., 550°F., 25 lbs., ext. surface condenser, 3 ph., 60 cyc., 2400 volts, 3600 RPM
1—5000 KW 6250 KVA, G.E. 3600 RPM 175/200 lbs. I.SP. 100" S.H. Condensing 3 ph. 60 cy 2300/4000v. Surface Cond. & Aux.
1—2000 KW G.E. 6600c, 3 ph., 60 cy. with 175 lb. cond. turbine and dir. conn. exciter
1—1500 KW G.E. 2300v., 3 ph., 60 cy. with G.E. 225 lbs. cond. turbine, surface condenser
2—750 K.W G.E. condensing, 3600 250 lbs. Surface condenser, 3 ph. 60 cyc. 440v. dir. conn. exciters
1—300 K.W. G.E. non-condensing 175 lbs., 5/15 lbs. B.P. 3 ph., 60 cyc., 480 v. Dir. conn. exciter
1—1000 KW. G.E. 2300/4150v, 3 ph., 60 cy. with 135/150 lb. condensing turbine

BELYEA COMPANY INC.
51 Howell St. Jersey City 6, N. J.
Phone—Journal Square 2-3334
ALSO N. Y. CITY LINE—RECTOR 2-7150

TIME SWITCHES FOR SALE

250—Type T-17S time switches, 40 amp, 230 volt, 2 pole single throw, equipped with 2 on, and 2 off riders for 2 on and 2 off operation. Switches equipped with 6 watt B-8 motor for 20 deg. to 110 deg. F. temperature range operation. Model 3T175BB1. For socket type mounting. First-class operating condition, attractively priced. Address replies to

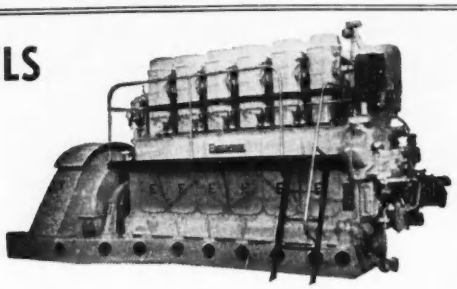
FS-8545, Electrical World, 520 N. Michigan Ave., Chicago 11, Ill.

NEW ENTERPRISE DIESELS

WITH 300 KW IDEAL A.C. GENERATORS

FOR

IMMEDIATE DELIVERY



OTHER DIESELS AVAILABLE
UNIT CAPACITIES—10 TO 1420 KVA
A.C.—50 AND 60 CYCLES

A PARTIAL LIST OF OUR INVENTORY

KVA	Make	Model	HP	RPM	KVA	Make	Model	HP	RPM
1420	Fairbanks Morse	38D8⅛	1600	720	312	General Motors	8-268A	450	1200
1250	General Motors	16-278A	1600	720	300	Fairbanks Morse	YVA	360	257
900	General Motors	12-567	1080	720	200	Buckeye	80	240	600
625	Superior	OS	750	327	125	General Motors	3-268A	150	1200
425	Baldwin	VO-6	510	450	75	General Motors	6016-E	90	1200
375	Enterprise	DSG-6	450	450	62	Int'l Harvester	UD-18	76	1200

WRITE FOR COMPLETE INFORMATION

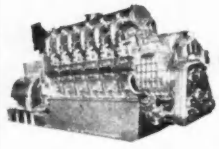
Engineered AGSCO DIESEL POWER

A. G. SCHOONMAKER Company, Inc.

Diesel Engines • Power Machinery

ESTABLISHED 1898

ENGINE DIVISION, 50 CHURCH STREET, NEW YORK 7, N. Y.



DIESEL GENERATOR PLANTS

1000 KW TO 100 KW

IMMEDIATE DELIVERY

HEMCO

1000 KW, 2400 Volts, 3 Phase, 60 Cycle, 720 RPM, General Motors and Fairbanks-Morse
750 KW, 2400 Volts, 3 Phase, 60 Cycle, 720 RPM, General Motors
300 KW, 450/2400 Volts, 3 Phase, 60 Cycle, 1200 RPM, General Motors
100 KW, AC or DC, 1200 RPM, General Motors
900 HP, General Motors, Propulsion Unit Complete
General Motors Quads, Twins, and Singles
Fairbanks-Morse O.P. Model 38D-8 1/8 Diesel

HERCULES ELECTRIC MACHINERY and EQUIPMENT CO.

Telephone NEvada 6-2808 — **1412 So. Alameda Street**
Cable Address HEMCOY — **Compton 1, Calif.**

FOR SALE

1—**150 HP**, 220 V, 60 cy, AC, 3 ph, induction **GE motor** direct connected on cast iron base to GE 100 KW DC Generator unit with A/C starting compensator and fuse box and DC Western Electric volt regulator.

1—**100 KW**, DC, **GE Generator** with outboard bearing and pulley drive mounted on cast iron base.

1—**12.5 KW**, 1500 rpm **Fairbanks-Morse** DC motor.

1—**15 HP**, 675 rpm, DC, **West'h.** motor.

2—**15 HP**, 550 rpm, DC, **West'h.** motors.

1—**25 HP**, 535 rpm, DC, **West'h.** motor.

2—2 HP, 900 rpm, DC, **West'h.** motors.

1—**3 HP**, 1700 rpm, DC, **Fairbanks-Morse** motor.

1—**10 HP**, 400/1200 rpm, variable speed, 230 V, **GE** motor together with **GE** starter and controls.

We have converted our 10-ton Cleveland 60 ft. traveling crane and all other equipment over to alternating current and are offering above motors, etc., for sale at very low prices.

TIPS ENGINE WORKS

P. O. Box 896 — **Austin 5, Texas**

500 KVA TRANSFORMERS

3—**Transformers, 500 KVA, 1 phase, 60 cycles substractive polarity, 2300 H.T. volts, 460 volts L.T., Type ODSC, Gals. oil 407, Spec. 9649B, Temperature rise 55 c, Impedance at 75 degree C 4.1%, Serial #714538, 39, 40, Allis-Chalmers Mfg. Co., Pittsburgh Transformer works, Pittsburgh, Pa., U.S.A. Excellent condition.**

FS-8311, Electrical World
330 West 42nd St., New York 18, N. Y.

FOR SALE

One 1,000 KW G.E. turbo unit incl. condenser, auxiliaries, foundation plans—being replaced by larger unit.
750 KW Whse. turbo unit
Two 2000 gpm motor-driven pumps
10,000 #/hr. Deaerating Heater

ROOM 4200, 141 W. JACKSON BLVD.
CHICAGO, ILLINOIS

BOILERS OF ALL SIZES.
TURBO GENERATORS TO 3000 K.W.
UNIFLOW ENGINE SETS, A. & D.C.
TRANSFORMERS
OIL ENGINES AND SETS.
Send listings of all kinds.
JAMES K. HOOPER
50 Church St., N. Y. — Phone: Barclay 7-6890

Buying
Good USED Equipment

is frequently the difference between having needed equipment or doing without it.

"SUCCESSFUL OPERATION GUARANTEED" *Belyea*

We Rebuild in accordance with N.I.S.A. Standards

D. C. MOTORS

Qu.	HP	Make	Type	Volts	Speed
1—	2000	Whse.		600	600/720
1—	1750	Whse.		600	550/700
2—	1500	Whse.		525	600
1—	1200	Whse.		600	525/700
1—	700	G.E.	MCF	600	150/525
1—	650	G.E.	MPC	250	115/145
1—	600	Whse.		600	800/950
2—	600	G.E.	MPC	600	600/720
1—	335	Whse.	MQ	250	300/900
1—	200/300	G.E.	MPC	220	360/920
1—	275	Whse.	QM-600.8	230	425/850
1—	250	G.E.	MPC	230	400/500
1—	230	Al. Ch.		230	900
3—	150	Whse.	SK-200	230	600
1—	150	Cr. Wh.	CMC-65H	230	1150
1—	150	G.E.	MPC	230	230/450
1—	150	Cr. Wh.	152HL	230	300/1050
3—	150	Cr. Wh.	TEFC-87H	230	890
1—	150	G.E.	CD-B-Brg.	600	250/750
2—	125	G.E.	CO	230	625
1—	125	El. Dy.	308	230	750/1560
1—	118	Cr. Wh.	JHL	230	1200
1—	100	G.E.	CD-175	230	365/730
1—	100	G.E.	MPC	230	225/450
3—	100	Whse.	SK-Vert.	230	485/950
3—	100	Rel.	1050T	230	400/1300
1—	80	El. Dy.	308	230	475/950
3—	75	Cr. Wh.	53H-TEFC	230	860
1—	75	Whse.	SK-180	125	650
2—	75	G.E.	CDM-1126Y	230	2000

TURBO GENERATOR SETS

See ad on page 156

SYNCHRONOUS CONDENSERS

Qu	KVA	Make	Type	Volts	Speed
1	5140	Whse.		4150	600
1	4000	G.E.	TSC	2400/4150	900
	3000	Whse.		2400	720
	3000	G.E.	ATI	4800	720

MOTOR GENERATOR SETS

3 Ph. 60 Cycle

Qu.	KW	Make	Speed	DC Volts	AC Volts
1	2000(30)	Whse.	720	600	2300
1	1500	G.E.	360	275	2200/4400
1	1500	G.E.	600	600	4150
1	1500	Whse.	600	600	4150
1	1250	G.E.	600	275	2300/4150
1	1000	Cr. Wh.	720	250	2300/4150
1	1000	Whse.	514	250	4000
1	1000	Whse.	720	600	2300/4150
1	1000	Whse.	900	600	2300/4150
1	800	3UGE	1200	240	2300
1	500	G.E.	720	125	2300/4150
1	500	G.E.	720	600	4400
1	750	Whse.	720	275	2300/4150
1	400	G.E.	720	250	440/2300
1	400	G.E.	1200	120/240	440
1	350	G.E.	900	125	4150
1	300	G.E.	1200	120/240	440
1	250	Whse.	1200	240	440
1	150	Cr. Wh.	1200	250	220/440
1	100	G.E.	1200	250	2200

ROTARY CONVERTERS (60 cycle)

Qu.	KW	Make	Speed	DC Volts	AC Volts
1—	2000	G.E.	514	600	13200
1—	2000	G.E.	450	600	13200
1—	1000	Whse.	900	600	11000
1—	750	Whse.	900	600	13200
1—	500	Whse.	900	250	6600

All units can be furnished with AC and DC Control

MERCURY ARC RECTIFIERS

1	1000	Al. Chal.	B-612	625	13500
*1	1000	B-B	25/60 cy.	625	6600/13200
1	750	G.E.	RHW	575	2300/4000

*Complete with full automatic A.C. and D.C. controls.

A. C. MOTORS—3 Ph. 60 Cycle

Synchronous

Qu.	HP	Make	Type	Volts	Speed
2—	3700	G.E.	TS	2300	257
1—	2100	G.E.	ATI	4000	514
2—	2000	Whse.		2200	120
1—	1470	Whse.		2300/4600	900
1—	1000	Whse.	MILL	2300	189.5
2—	900	Al. Ch.	Eng. (new)	2200	150
1—	600	Whse.		440	360
1—	500	G.E.	ATI	480	900
2—	500	G.E.	TS-9832	4160	600
1—	450	Whse.		2200	128.5
2—	350	G.E.	TS	2200	150
1—	320	G.E.	ATI	2300	600
1—	308	Al. Ch.		440	600
1—	300	G.E.	ATI	440	720
1—	300	Whse.		2300	720

Slip Ring

1—	1000	Whse.	CW	2300	705
2—	700	Whse	CW	2200	900
1—	600	G.E.	MT	440	720
1—	500	G.E.	IP	550	505
3—	450	G.E.	IM	440	505
1—	500	G.E.	MIII-IM	2200	450
3—	350	Whse.	CW	2200	900
1—	350	G.E.	MT-442y	4000/2300	257
1—	300	Al. Ch.	ANY	2300	505
1—	250	G.E.	MT	4000	257
1—	250	G.E.	MT-559S	2200	750
1—	135	G.E.	IM	2300	700
4—	125	G.E.	MT-586Y	2300	435

Squirrel Cage

1—	250	G.E.	KT-555	440	1780
1—	200	G.E.	KT-557	440	1800
1—	200	G.E.	IK	550	865
1—	150/50	Whse.	CS	440	179/343
1—	125 (new)	G.E.	KF TEFC	440	1190
1—	125	G.E.	KF-6328L	440	3558
2—	100	G.E.	KT-543	220/440	1750
1—	100	G.E.	IK	440	57

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Every Machine Is Owned Outright by Us

Belyea COMPANY, INC.

MAIN OFFICE AND SHOP
51 HOWELL ST., JERSEY CITY, N. J.

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UNITS UP TO 5000 KW
AVAILABLE IN STOCK

OPPORTUNITIES!

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New and used equipment recently released from service by a number of electric and gas utility companies

POWER PLANT EQUIPMENT
CONSTRUCTION EQUIPMENT
SUBSTATION EQUIPMENT
TRANSMISSION LINE MATERIALS

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EBASCO SERVICES INCORPORATED
(APPARATUS EXCHANGE)
120 Wall St., New York 5, N. Y.

DIESEL GENERATOR UNITS

IN STOCK—IMMEDIATE SHIPMENT

2—1420 KVA—FAIRBANKS MORSE—NEW ALTERNATORS DIRECT CONNECTED TO FAIRBANKS MORSE MODEL 38D8-1/8 1600 HP—720 RPM—DIESEL ENGINES.

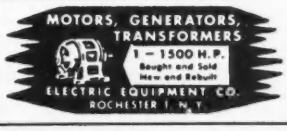
2—1250 KVA—CROCKER WHEELER—NEW ALTERNATORS DIRECT CONNECTED TO FAIRBANKS MORSE MODEL 38D8-1/8 1600 HP—720 RPM—DIESEL ENGINES.

2— 620 KW—240 VOLT—DC GENERAL ELECTRIC GENERATORS DIRECT CONNECTED TO ALCO TYPE 6—12½ X 13-T 900 HP—700 RPM DIESEL ENGINES.

ENGINES NEW LATE 1944—RELATIVELY FEW HOURS OPERATION

WALTER H. WILMS & COMPANY

2526 GUARDIAN BUILDING, DETROIT 26, MICHIGAN
WOODWARD 1-1856—1-1857



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2000 Sets #4 and 44 Boxes #4 AM John Crane Packing

Detailed listing will be furnished on request

For Price contact
Mr. N. C. STIREWALT, V. P.

CENTRAL ILLINOIS PUBLIC SERVICE COMPANY
Illinois Building Springfield, Ill.

Power Equipment

Released by Utilities & Industrials

Turbines, Generators, Steam and Oil Engines, Boilers, Motor Generators, Rotaries, Transformers, Motors, Compressors, Induction Voltage Regulators, Oil Circuit Breakers, etc.

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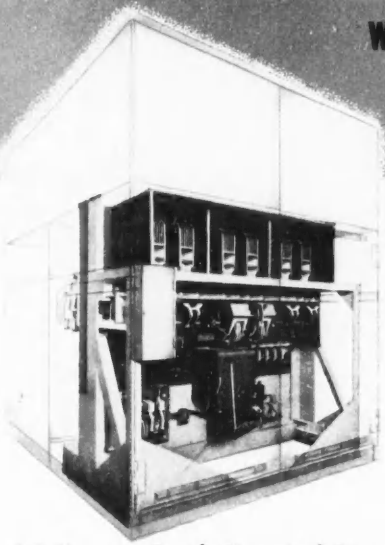

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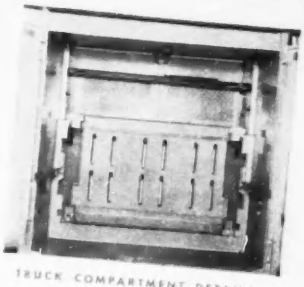

TRUCK COMPARTMENT DETAILS

- Construction: sheet-steel panels on all-welded frame.
- Compartment arranged so that circuit breaker is completely enclosed when truck is in compartment.
- Steel compartment doors are double-hinged and can be closed when truck is removed from compartment.
- Safety panel moves forward to cover terminals when breaker is removed — prevents accidental contact with terminals.
- Non-magnetic materials used wherever necessary to prevent heating in structure.

CONTROL MECHANISM

- Access to control mechanism is gained through a small door in main compartment door.
- Mechanism is designed to automatically lock the truck when breaker is in Disconnected Test, or Operating Position.
- Truck can be moved to any of these positions without opening main compartment doors; thus complete protection is given to the operator and the mechanism.
- Special interlocking mechanism prevents the truck from being moved into or out of operating position unless the breaker has been tripped and all contacts opened.

APPLICATION RATINGS—TYPE LG CIRCUIT BREAKERS

	PANTOGRAPH-MOUNTED	TRUCK-MOUNTED
600 V A-C	2000-3000 A	4000-6000 A
250 V D-C	2000-5000 A	6000-10,000 A

2-, 3-, and 4-Pole. Electrically operated.
75,000 and 100,000 amperes R.M.S. Interrupting Rating.

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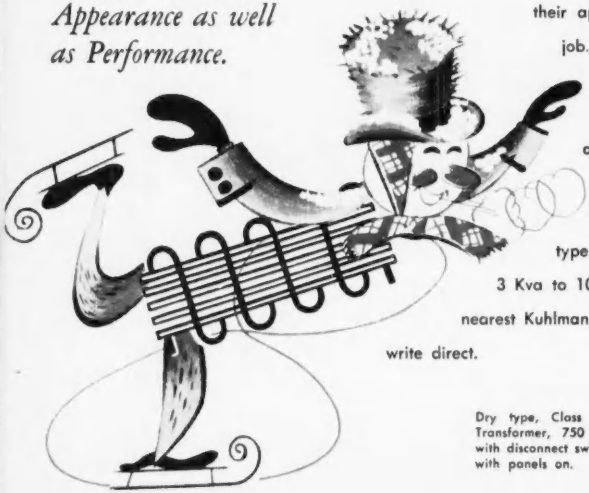
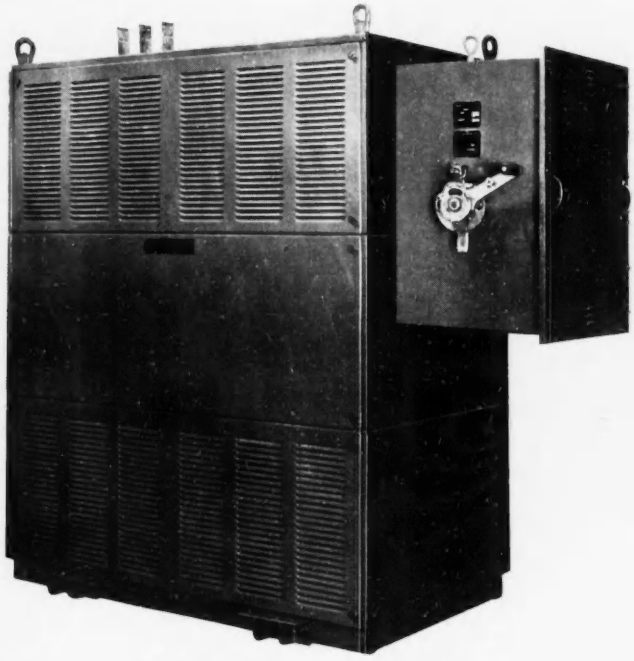
"Cool-Man" says:

KUHLMAN Dry Type Transformers for Appearance as well as Performance.



Kuhlman Dry Type Transformers with Class "B" insulation are ideal for indoor industrial installations. They are designed for the same dependable performance characteristic of all Kuhlman transformers, yet with an eye toward their appearance on the job. Utility combined with modern lines of design assures satisfaction. For complete particulars on dry type transformers from 3 Kva to 1000 Kva, call your nearest Kuhlman representative, or write direct.

Dry type, Class "B" Insulated Power Transformer, 750 Kva, 60 Cycle, 480, with disconnect switch, showing L.V. side, with panels on.



KUHLMAN ELECTRIC COMPANY

BAY CITY, MICHIGAN

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TRANSFORMER TOPICS *by* KUHLMAN

QUESTION:

Two banks of transformers are to be operated in parallel. One bank consists of three units connected in closed delta and the other bank of two units in open delta. The impedances of all transformers are equal and the temperature rise under load is not to be exceeded on any unit.

Determine the Kva output compared with the rating of the delta bank.

ANSWER:

The circuit diagram may be drawn as in fig. 1.

Let $I_A = I$; $I_B = I \lfloor 240°$; $I_C = I \lfloor 120°$

Z = impedance of each transformer.

Therefore, the impedance of the transformer units in parallel such as Nos. 1 and 2 and Nos. 3 and 4, $= \frac{Z}{2}$

From fig. 1, the voltage equations are

$$ZI_{BC} + \frac{ZI_{CA}}{2} + \frac{ZI_{AB}}{2} = 0$$

or $2I_{BC} + I_{CA} + I_{AB} = 0$ ..... (1)

Also, $I_C = I_{BC} - I_{CA} = I \lfloor 120°$ ... (2)

And $I_B = I_{AB} - I_{BC} = I \lfloor 240°$

Therefore $I_{CA} = I_{BC} - I \lfloor 120°$ ... (3)

and $I_{AB} = I_{BC} + I \lfloor 240°$ ... (4)

Substituting equations (3) and (4) in (2) we get

$$2I_{BC} + I_{BC} - I \lfloor 120° + I_{BC} + I \lfloor 240° = 0$$

$$\text{or } I_{BC} = \frac{I \lfloor 120° - I \lfloor 240°}{4} =$$

$$\frac{1}{4}\left(\frac{1}{2} + j\frac{\sqrt{3}}{2} - \frac{1}{2} + j\frac{\sqrt{3}}{2}\right) I$$

$$= \frac{j\sqrt{3}I}{4} = j\,0.433\,I \text{ ..... (5)}$$

In other words, transformer No. 5 supplies a current 0.433 I

Now: $I_{CA} = I_{BC} - I \lfloor 120° = j\,0.433\,I + (0.5 - j\,0.866)\,I =$

$(0.5 - j\,0.433)\,I = 0.622\,I$

$I_{AB} = I_{BC} + I \lfloor 240° = j\,0.433\,I - (0.5 + j\,0.866)\,I =$

$(-0.5 - j\,0.433)\,I = 0.662\,I$

Therefore the current in transformers Nos. 1, 2, 3 or 4 is $\frac{0.622\,I}{2} =$ .331 I, which is less than the current in transformer No. 5. The latter therefore limits the bank capacity.

If transformer No. 5 carries rated current, the line current is

$I = \frac{1}{0.433} = 2.31$ times rated current of each transformer.

The following relations therefore hold:

1. The output in terms of the rating of one transformer $= \sqrt{3}\ V\ I = \sqrt{3} \times 1 \times 2.31 = 4$. This is $4/5 \times 100 = 80\%$ of total rating of the five transformers.
2. As the load capacity of the three transformers in closed delta is 3 and that of the two in open delta is 1.732, the total load capacity of the two banks is 4.732 or $4/4.732 \times 100 = 84.5\%$ of total rating, without exceeding the temperature rise of transformer No. 5.
3. Although the number of banked units has been increased from 3 to 5, or 66-2/3%, the actual load capacity has been increased only from 3 to 4, or 33-1/3%, an uneconomical use of transformer capacity.
4. Adding 1 more unit, or 33-1/3%, to complete two closed delta banks, would increase the load capacity 66-2/3%, or from 133-1/3% to 200% of the original bank capacity.

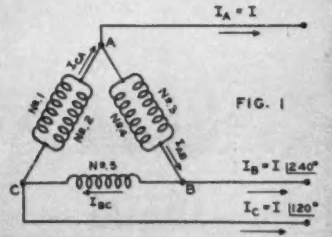

FIG. 1